MnDOT Traffic Safety Data Analysis Project: A Collaborative Project with HDR





The Power of Prediction; An Innovative Traffic Safety Tool to Help Prevent Traffic Crashes



ZERO DEATHS





What if we could predict where and when crashes are most likely to occur?



"Traditional Safety Approach"

- Detailed crash analysis to identify root factors
- Relate root factors to infrastructure conditions
- Prioritize road segments for funding that are lacking the desired infrastructure conditions





Driver Characteristics Approach

- Develop a predictive model associated with driver characteristics
- Identify at-risk segments based on driver characteristics
- Determine interventions for high-risk segments



1. Introduce New Data

- Average Vehicle Speed
- Citation/Traffic Stops
- Driver Attributed Crash Behavior

2. Use Sophisticated Statistical Methods

- Rigorous application of advanced statistical techniques
- Quantitative not qualitative assessment of importance of each factor

Data from 2017-2023 One record for every road segment, day, hour 74,050,362 records in Database







Artificial Intelligence/ Machine Learning

Negative Binomial Regression **Bayesian Network**

Model Enables Risk Assignment Directly Linked to Driver Behaviors and Characteristics

- All three methods can be used to derive probabilities/risk of fatal crashes
- AI/ML model was too "black box" and hard to interpret
- General linear model and Bayesian Network generated very similar results
- Driver Behavior/Characteristics Driving Risk, not Infrastructure



Statistically Significant Predictors of Fatal/Severe Crashes

- Functional Class
- District
- Total Number of Crashes

- Number of Crashes involving an:
 - Older Driver
 - Younger Driver Speed

DUI

Unbelted Occupant











If we know these driverbased factors are at an elevated severe crash risk

We can be proactive



DEAT



ZERO







Enforcement



Crash Foresight Tool



DEPARTMENT OF TRANSPORTATION	Predictive Fa Crash Risk L	atal/Severe evels	Roadways	Crashes	State Patrol Stops	Crashes vs Stops	Ancillary Info/Engineering	g Layers About	
Segment Summary Statistics				Segment Risk Levels Map			<u>Map Legend</u>	Map Filters	(j)
Segment out of 2,2:	Count Selection 5 36 Total Segments	Segment Count Percentage 0.22% of Total Segments		Baxer Brainero	Solana State Forest	Highway	Highway Segment Risk Level 1: Highest 20% 2: 61-80% tile	Select MnDOT Dist.	~
Segment 6 out of 14	Length Selection 2 Miles 4,266 Total Miles	Segment Length Percentage 0.44% of Total Miles		-3	Mille Lacs Reservation 1343 ft		 3: 41-60%tile 4: 21-40%tile 5: Lowest 20%tile 	Select MnDOT Dist. Rank	*
All Crashes Selection 5,194 out of 56,096 Total Crashes		All Crashes Percentage 9.26% of Total Crashes				County B	oundaries	Select County - All -	~
Severe Crashes Selection 76 out of 2,177 Total Severe Crashes		Severe Crashes Percentage 3.49% of Total Severe Crashes		at Cloud			Districts	County Rank - All -	~
Predicted # of Fatal/Severe Crashes in Next 5 Yrs 53		Est. Probability of >1 Fatal/Severe Crash in Next 5 Yrs 0.92			Ramsey	+ State Patr	rol Districts	Select SHP Dist.	~
Highway Segment	t Risk Level				rd 2500		5 S S	Select SHP Dist. Rank	
Segment ID 🕴	Route Name 💠	Segment From \$ · · ·	Segment To 💠 …	Segment Length 💠 …	Through Lanes 💠 …	Functional Class 💠 🚥	Area Type 💠 🤹	- All -	~
3,228	MN 210	MN 210 start of divided se	MN 210 end of divided se	8.444216771137617	4	Principal Arterial - Other	Small Urban	Select Hwy. Agency	
3,662	MN 65	Isanti / Anoka CL	MN 65 start of divided seg	14.381429466187951	4	Principal Arterial - Other	Small Urban	- All -	~
3,790	US 169	US 10	CSAH 4	10.970626133722215	4	Principal Arterial - Other	Minneapolis_St. Paul, MN 👦		
d ctal: 5 Selection: 0							Þ		(5

DEPARTMENT OF TRANSPORTATION	redictive Fa Crash Risk L	atal/Severe evels	Roadways	Crashes	State Patrol Stops	Crashes vs Stops	Ancillary Info/Engineerin	g Layers About	-
	Segment Sum	mary Statistics		Segmen	<u>t Risk Levels Map</u>		<u>Map Legend</u>	Map Filters	i
Segment Count Selection 5 out of 2,236 Total Segments		Segment Count Percentage 0.22% of Total Segments		Pillsbury State Forest Baxtel Bain	nerd Bay Lake	Highway Segment Risk Level 1: Highest 20% 2: 61-80%tile	Segment Risk Level 1: Highest 20% 2: 61-80%tile	Select MnDOT Dist. - All -	~
Segment Length Selection 62 Miles out of 14,266 Total Miles		Segment Length Percentage 0.44% of Total Miles			1454 R	Mille Lats Lake	 3: 41-60%tile 4: 21-40%tile 5: Lowest 20%tile 	Select MnDOT Dist. Rank - All -	~
All Crashes Selection 2,069 out of 56,096 Total Crashes		All Crashes Percentage 3.69% of Total Crashes		33	Platte Lake Mille Rese	County E	Boundaries	Select County - All -	×
Severe Crashes Selection 47 out of 2,177 Total Severe Crashes		Severe Crashes Percentage 2.16% of Total Severe Crashes		Morrison	.1343 m	Mille Lacs MnDOT	Districts	County Rank - All -	~
Predicted # of Fatal/Severe Crashes in Next 5 Yrs 32		Est. Probability of >1 Fatal/Severe Crash in Next 5 Yrs 0.86				State Pat	rol Districts	Select SHP Dist.	•
Highway Segment Risk I	Level							Select SHP Dist. Rank	
Segment ID 💠 …	Route Name 💠 💀	Segment From + ···	Segment To 💠 …	Segment Length 💠 …	Through Lanes 💠 🚥	Functional Class 🛛 💠 …	Area Type 💠 👘	1 - Top 1-5	*
3,220	MN 371	MN 371B	CSAH 77	6.9293120406715385	4	Principal Arterial - Other	Small Urban	Select Hwy. Agency	
3,228	MN 210	MN 210 start of divided se	MN 210 end of divided se	8.444216771137617	4	Principal Arterial - Other	Small Urban	- All -	~
3,237	MN 25	Crow Wing / Morrison CL	MN 210	16.08281471828885	2	Minor Arterial	Small Urban	I	(D

DEPARTMENT OF TRANSPORTATION C	redictive Fa Trash Risk Lo	atal/Severe evels	Roadways	Crashes	State Patrol Stops	Crashes vs Stops	Ancillary Info/Engineerin	ng Layers Abo	ut
	Segment Sum	mary Statistics		Segment Risk Levels Map			<u>Map Legend</u>	Map Filte	ers (j
Segment Cour 5 out of 2,236 Tot	Segment Count Selection 5 out of 2,236 Total Segments		Segment Count Percentage 0.22% of Total Segments		Baster Branerd	Highwa	 y Segment Risk Level 1: Highest 20% 2: 61-80%tile 	Select MnDOT Dist. - All -	v
Segment Leng 62 M out of 14,266	Segment Length Selection 62 Miles out of 14,266 Total Miles		Percentage 6 liles	Sharme au Lake Fish Line Abace of	100 e		 3: 41-60%tile 4: 21-40%tile 5: Lowest 20%tile 	Select MnDOT Dist. Rank	~
All Crashes Selection 541 out of 56,096 Total Crashes		All Crashes Percentage 0.96% of Total Crashes		doman	Crow Wing	Suthan County	Boundaries	Select County Morrison	×
Severe Crashes Selection 17 out of 2,177 Total Severe Crashes		Severe Crashes Percentage 0.78% of Total Severe Crashes		ng Prane	Little Falls	MnDOT	Districts	County Rank 1 - Top 1-5	~
Predicted # of Fatal/Severe Crashes in Next 5 Yrs 18		Est. Probability of >1 Fatal/Severe Crash in Next 5 Yrs 0.78		Sign Sign 1964 1 Little Garon, Big	and the second s	+ State Pa	trol Districts	Select SHP Dist. - All -	~
Highway Segment Risk L	evel			Laite Sto	oarns Carel			Select SHP Dist. Rank	
Segment ID 💠 •••	Route Name 🔹 🕂	• Segment From \$ •••	Segment To 💠 …	Segment Length 💠 🚥	Through Lanes 💠 …	Functional Class + ••	• Area Type 💠 🖕	- All -	v
3,246	US 10	Todd / Morrison CL	Todd / Morrison CL	8.70825053094611	4	Principal Arterial - Other	Rural	Select Hwy. Agency	
3,289	US 10	CSAH 14	Todd / Morrison CL	11.902935440930813	4	Principal Arterial - Other	Rural	- All -	*
3,382	US 10	CSAH 34	CSAH 52	10.30095440846253	4	Principal Arterial - Other F.	Small Urban		(5

























DEPARTMENT OF TRANSPORTATION	Predictive Fa Crash Risk L	atal/Severe evels	Roadways	Crashes	State Patrol Stops	Crashes vs Stops Ancillary Info/Engine	ering Layers About
	Segment Sum	mary Statistics		<u>Segmen</u>	<u>t Risk Levels Map</u>	Map Legend	Map Filters
Segment Count Selection 183 out of 2,236 Total Segments		Segment Count Percentage 8.18% of Total Segments		State Foreit Law	Hill River State Forest	Highway Segment Risk Level 1: Highest 20% 2: 61-80%tile	Select MnDOT Dist.
Segment Length Selection 1,881 Miles out of 14,266 Total Miles		Segment Length Percentage 13.18% of Total Miles		st ke	2800	Fond du La: State Forest 4: 21-40%tile 5: Lowest 20%tile	Select MnDOT Dist. Rank - All
All Crashes Selection 31,785 out of 56,096 Total Crashes		All Crashes Percentage 56.66% of Total Crashes		n ¹⁷⁹⁰ ft	Mile Fores 1454 Aller 3 Aller Fores Resolution 133 f	County Boundaries	Select County - All - ~
Severe Crashes Selection 835 out of 2,177 Total Severe Crashes		Severe Crashes Percentage 38.36% of Total Severe Crashes		3 n. Alexandria		MnDOT Districts	County Rank - All - V
Predicted # of Fatal/Severe Crashes in Next 5 Yrs 599		Est. Probability of >1 Fatal/Severe Crash in Next 5 Yrs 0.74		2600	Ramsey	+ State Patrol Districts	Select SHP Dist.
Highway Segment Ris	k Level	1					Select SHP Dist. Rank
Segment ID 🔹 🕂	• Route Name \$ ••	Segment From \$ · · ·	Segment To 💠 …	Segment Length 💠 🚥	Through Lanes 💠 🚥	Functional Class 💠 🚥 Area Type 💠	- All - 🗸
3,009	MN 371	CSAH 66	US 2	9.705733153344696	2	Principal Arterial - Other Rural	Select Hwy. Agency
3,020	MN 371	MN 34	CSAH 66	11.174995721182137	2	Principal Arterial - Other Rural	- All - ~
3,039	MN 371	CSAH 6	MN 34	10.992145791128868	2	Principal Arterial - Other Rural	

Questions?

