2020

Statewide Bicycle and Pedestrian Systemic Safety Analysis 2020

SYSTEMS PLANNING BUREAU

Introduction

NHTSA reports that "In the United States, the number of traffic crashes involving a bicyclist or pedestrian has been increasing since 2009." Similar to national trends, Iowa has also seen an increasing number of crashes involving bicyclist and pedestrians. Particularly concerning is that bicyclists and pedestrians are overrepresented in fatal and serious injury crashes when considering their mode share. Although biking and walking only comprise 3.8 percent of the state's commuting mode share (US Census Bureau), these forms of travel are represented in just over seven percent of the fatal and serious injury crashes. One reason for this over representation is that pedestrians and cyclists are often more vulnerable to the effects of speed and lack physical protection. This is especially true for pedestrians, where vehicle speed at impact directly increases the likelihood and risk of severe injuries.

In order to effectively address this over representation, an analysis to identify the risk associated with particular road segment and intersection features on Iowa's roadway network was developed. In contrast to traditional safety analysis, which focuses on identifying locations of high crash frequency, this analysis focuses on roadway or intersection features that are associated with higher risk of crashes involving a pedestrian or bicyclist. The main reason for this is the underlying assumption that crashes involving pedestrians and bicyclist are infrequent and broadly spread across the network. Therefore, high concentrations of these crashes are very rare, and relying solely on a traditional safety analysis framework would be ineffective. The systemic analysis approach that is described in further detail below allows agencies to focus on crash risk rather than crash history to identify and prioritize sites for improvements. This, in conjunction with a traditional safety analysis, supports a comprehensive safety framework that addresses both the risk associated with particular features along with the crash history.

Purpose

The purpose of this analysis is to is gain a better understanding of the crash risk of particular roadway and intersection features for pedestrians and bicyclists in Iowa. This understanding will provide decision makers with a data-driven approach for identifying roadways and intersections with the greatest risk of crashes for pedestrians and bicyclists. The intent is that the results of this analysis will lead to more efficient use of the limited resources to make improvements that have the greatest chance of minimizing risk and the frequency of these crashes.

The development of a statewide analysis addressing bicyclist and pedestrian crashes was identified in several state long-range planning documents including the Iowa in Motion 2045 State Transportation Plan, Iowa Bicycle and Pedestrian Long-Range Plan, and 2019-2023 Iowa Strategic Highway Safety Plan. These strategies either directly addressed the development of this analysis or indirectly identified a need for such an analysis to systematically identify locations. Below is a brief description of the related strategies identified in these plans.

- Iowa in Motion 2045 State Transportation Plan
  - "Evaluate key safety challenges pertaining to bicycling and walking and develop crash reduction strategies."
- Iowa Bicycle and Pedestrian Long-Range Plan
  - "Identify the primary urban and rural crash types occurring in Iowa and develop strategies for reducing crashes."
  - "Develop methodology for bicycle and pedestrian safety audits of high crash corridors and intersections to identify adequate countermeasures."
- 2019-2023 Iowa Strategic Highway Safety Plan
  - "Conduct enforcement campaigns related to bicycle and pedestrian awareness at targeted intersections."

Challenges

There are several challenges with analyzing bicyclist and pedestrian crashes that makes a traditional safety analysis approach difficult. Below are some examples of the challenges faced when analyzing bicyclist and pedestrian crash data.

- Frequency of Crashes
  - Unlike vehicle crashes, bicyclist and pedestrian crashes occur much less often. In performing a traditional safety analysis, the frequency of crashes is typically used to identify hot spots and statistically significant trends. Consequently, when traditional approaches are applied to bicyclist and pedestrian crashes, it often results in misleading conclusions or identifies locations with variable safety performance.
- Exposure data
  - Exposure data for vehicle traffic is common and is typically expressed in terms of Vehicle Miles Traveled (VMT) or Average Annual Daily Traffic (AADT). Pedestrian and bicyclist travel is counted less often and typically only for certain projects or locations. Currently, Iowa does not have either statewide count data or estimated counts for either pedestrians or bicyclists.
- Underreporting
  - Traditionally, crashes involving pedestrians and bicyclists have been underreported. This underreporting occurs for a number of different reasons. In Iowa, for a crash to be officially reported it requires injury or property damage exceeding $1,500. This threshold means that in crashes involving a vehicle and a non-motorist, an injury must have

occurred, typically to the non-motorist, or damage to the vehicle or bicycle would need to exceed the $1,500 threshold. It is likely that many crashes occur between a non-motorist and a vehicle that don't meet these thresholds. These reporting thresholds also point to another issue related to underreporting, which is that a vehicle needs to have been involved. There are circumstances in which a pedestrian or cyclists may crash, and a vehicle is not present or is present and unknowingly involved and thus continues on its way. Additionally, there could be circumstances in which a non-motorist crashes with another (likely bicyclist to bicyclist or bicyclist to pedestrian), and there is no formal mechanism in Iowa for those incidents to be reported.

Approach/Methodology

The underlying approach to this analysis is a systemic one in which locations are identified based on a high risk of crashes as opposed to a traditional analysis which typically focuses on a high frequency or rate of crashes. The fundamental reason for choosing to use a systemic approach rest with the challenges stated above. The systemic approach is best when crash occurrences are few and when exposure of the mode is limited or unknown at specific locations. In Iowa, over a ten-year period there were just over 8,500 crashes involving a pedestrian or bicyclist. With relatively few crashes or exposure data available to use in a traditional analysis, the systemic approach provides an ideal approach for our department and other agencies to identify areas of greatest risk.

General Systemic Analysis Approach

The systemic safety approach "involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types. The approach provides a more comprehensive method for safety planning and implementation that supplements and complements traditional site analysis." The systemic approach gives agencies another tool to address safety by allowing them to consider the risk of a site instead of its crash history. The general attributes of a systemic safety analysis include:

- Identifying focus crash types and risk factors
    - Agencies need to identify a crash type to focus on, based on either statewide data or on an area identified in prior planning activities such as the State Strategic Highway Safety Plan (SHSP). Often the crashes associated with a focused crash types are randomly distributed across a network with few locations experiencing a cluster of crashes.
- Defining risk factors
    - After identifying a focus crash type, agencies associate those crashes with roadway or intersection characteristics. This association helps identify roadway characteristics that are correlated with a higher

  - frequency or rate of that crash type. These characteristics, also known as risk factors, can be used to identify and prioritize similar locations where no crash history currently exists.
- Screening and prioritizing the network
  - Risk factors (or roadway characteristics) are typically scored and weighted by agencies. This process of prioritizing characteristics allows agencies to take that information in combination and find areas within their roadway network that have higher concentrations of risk factors.

The resulting analysis will identify roadways and intersections that have the greatest risk, regardless of existing crash history at those locations. Agencies can in turn use this to help select appropriate countermeasures and prioritize projects.

Data Used

- Crash Data
  - Ten years of crash data from 2009-2018 was used in this analysis. Only non-motorist crashes involving pedestrians, skaters, those using a personal conveyance, wheelchair occupants, bicyclists, and bicycle passengers were included in the analysis. Data as accessed July 8th, 2019.
- Roadway data and Jurisdictional data
  - Roadway data was extracted from the Road Asset Management System (RAMS). The analysis included all paved roads within the state. Attributes included in the dynamic segmentation included number of lanes, average annual daily traffic (AADT), route name, shoulder width, shoulder type, shoulder rumble, speed limit, parking type, and median type. Jurisdictional data was also spatially joined to all the segments in the analysis including city, county, Regional Planning Agency (RPA), and Metropolitan Planning Organization (MPO). Roadways with minimum speed limits were eliminated from this analysis because pedestrian and bicyclist are prohibited from using facilities with minimum speed limits. The most recent access of this data was from September 20th, 2019.
- Intersection Data
  - All paved intersections within the state were analyzed by utilizing the department's intersection database. The intersections not included in this analysis were intersections on unpaved roads and intersections with more unpaved legs than paved. Additionally, intersections on minimum speed facilities were also excluded however, intersections at interchange ramp termini were retained. The intersection database was developed by Iowa State University's Institute for Transportation (InTrans) from 2013 to 2017 using roadway data, aerial imagery, and Google Streetview images. The version of the database used in this analysis was last updated on April 2017.

Analysis Methodology

Categorization of Crash Data

Each bicyclist or pedestrian crash within the analysis was assigned to one of eight categories that binned them according to crash type, urban or rural, and segment or intersection (see Figure 1). The initial split of the data was between pedestrians and bicyclists. For this analysis, we defined pedestrian crashes as those coded as involving pedestrians, skaters, people on personal conveyance, or individuals in wheelchairs. Bicyclists in this analysis were defined from the crash data as including pedalcyclists (bicycle/tricycle/unicycle/pedal car) and pedalcycle passengers.

The next binning of this data was the designation of crashes as urban or rural. There are many ways in which rurality is defined. For example, the Census Bureau defines metropolitan as urbanized areas of 50,000 or more population and urban clusters of at least 2,500 and less than 50,000 populations. The Census Bureau uses the term “urban area” to refer to both urbanized areas and urban clusters collectively. Similarly, FHWA defines “Urbanized Area” as 50,000 population or more, “Small Urban Areas” (from Clusters) between 5,000-49,999, and “Urban Areas” as 5,000+ in population. In order to mirror prior analysis in the State Bicycle and Pedestrian Long-Range Plan, we defined pedestrian or bicyclists crashes in incorporated areas as urban and all crashes outside of these areas as rural.

The final way in which crashes were binned for this analysis was by either segment or intersection. The same methodology for spatially selecting intersection and segment crashes in American Association of State Highway Transportation Officials (AASHTO’s) Highway Safety Manual (HSM) was adopted for this analysis. The HSM methodology for defining intersection crashes has two criteria that need to be satisfied. First, crashes must be within 250 feet of the intersection. Second, the crashes must be identified as intersection crashes in the crash report form. If these two thresholds are satisfied, then the crash was defined as an intersection crash. All other crashes were defined as segment crashes.

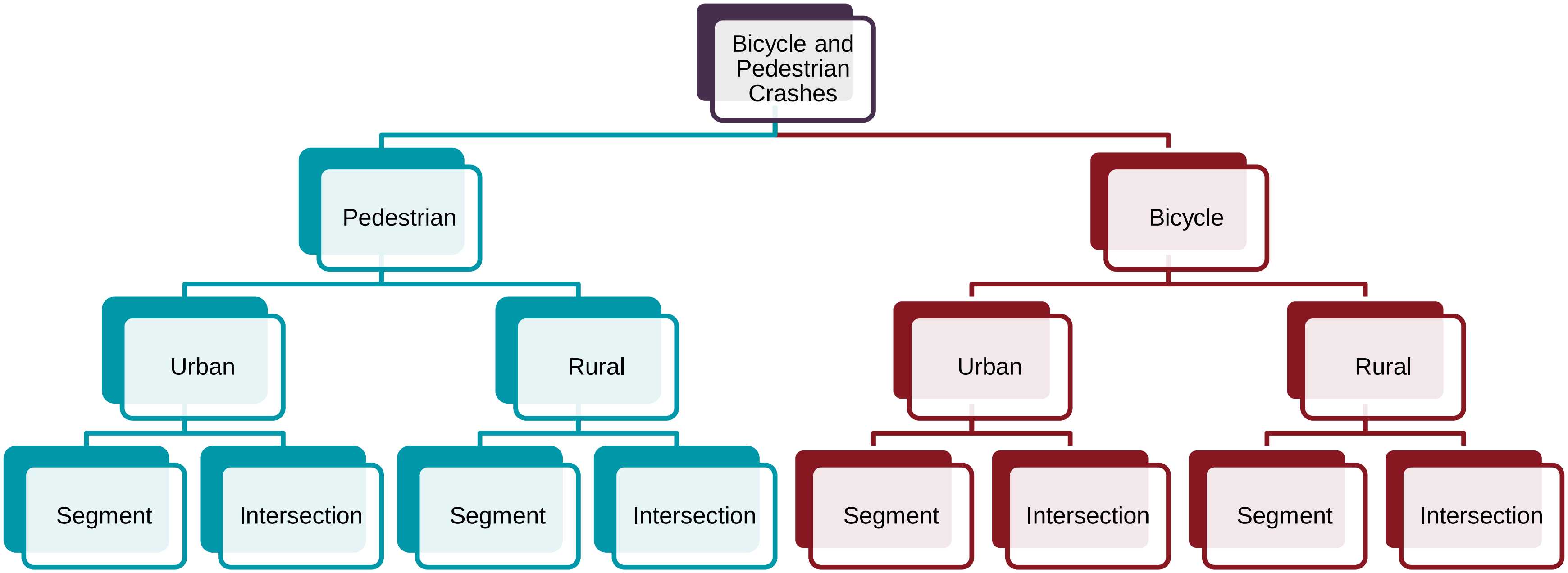

Figure 1: Category bins for systemic safety analysis.

Normalization, Weighting, and Composite Score Methodology

One objective of this analysis was to develop a composite score for every segment and intersection within Iowa. This composite score would represent the associated risk for a pedestrian or bicyclist at that location based on the combination of physical roadway or intersection characteristics (here after called attribute elements). The following is a description of the process by which the crash, roadway, and intersection data was analyzed to develop a composite score for each segment and intersection. The process of normalizing and weighting the data mirrors the approach used in Iowa's Infrastructure Condition Evaluation (ICE) tool.

After crashes were binned to one of the eight possible categories (described in the prior section), they were then further associated with the attribute of the segment or intersection they were spatially linked with. Figures 2 3 list the attributes for the segments and intersections, respectively. For segments, eight attributes were analyzed in urban areas and seven attributes were analyzed in rural areas. For intersections, seven attributes were included in the analysis.

Segment Attributes

- AADT
- Median Type
- Number of Lanes
- Parking Type (only urban)
- Shoulder Type
- Shoulder Rumble
- Shoulder Width
- Speed Limit

Figure 2: Segment attributes used in this analysis.

Intersection Attributes

- AADT
- Intersection Angle
- Intersection Type
- Number of Lanes
- Number of Legs
- Speed Limit
- Traffic Control

Figure 3: Intersection attributes used in this analysis.

Each attribute was represented by continuous values (such as AADT) or categorical values (such shoulder type). For attributes that had continuous values, categories were defined in order to associate the crash data. For example, for the AADT continuous values were binned into four categories including: 0-700, 701-1,500,1,501-3,000, and more than 3,000. For the attributes that represented continuous values, an effort was made to ensure that the bins or categories either mirrored or were similar to binning done in prior analyses, or were logical relative to its overall category. For example, the way that AADT was binned for this analysis was similar to how AADT was binned for the development of the State Bicycle and Pedestrian Map. For categorical values such as shoulder type, categories already existed, meaning all that needed to be done was to associate the crashes to the existing attribute values.

Rates

Crash rates were calculated after bins were assigned and crash data was associated with all the various attributes. These rates were based on either a per-mile or per-intersection calculation to emphasize the exposure of each attribute relative to its associated number of crashes within each bin. These rates are important to the analysis because they identify the relative risk associated with each attribute value. An example of this is presented in Figure 4 looking at AADT for Rural Bicycle Segments. In this example, the most crashes were associated with roadway segments with 3,000 or more AADT, these segments also had the highest calculated rate (0.16 bicycle crashes per mile). In contrast, the bin of 700-1,500 AADT had the second highest frequency of crashes but only the third highest rate. This demonstrates that within this analysis although frequency of crashes is considered, the rate of crashes is the key component used in identifying higher risk locations. Rates were calculated for every attribute in each category bin. Therefore, the rates calculated for rural bicycle segment AADT would be completely different than the rates calculated for urban bicycle segment AADT.

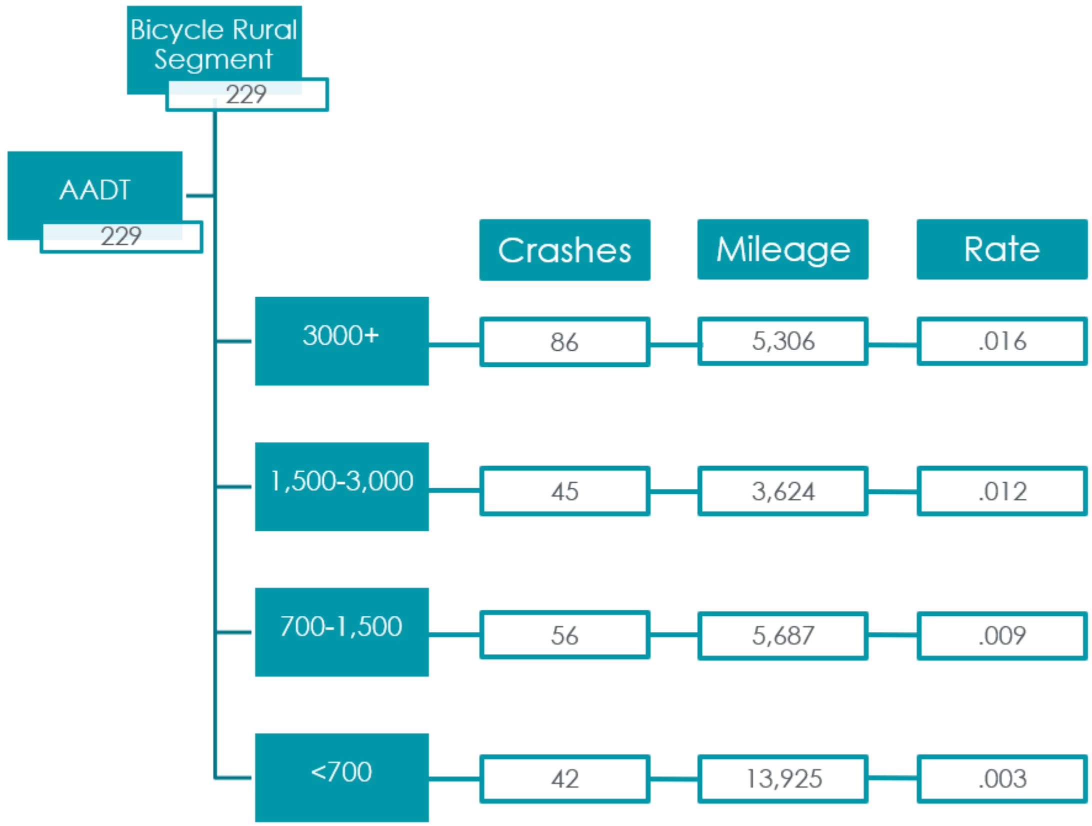

Figure 4: Example of rate calculation for bicycle rural segment AADT.

Normalization

To develop a composite score that effectively identified the segments and intersections with the greatest associated risk, it was important to develop a common numeric scale from 1-10 to analyze the rates described in the prior section. In order to do this, the range of rates for each attribute were analyzed by identifying the minimum and maximum rate. Again, using the example in Figure 4, the minimum rate calculated was 0.004 and the maximum value was 0.027. The range between these two values was 0.023. Applying this to a 1-10 numeric scale means that an interval of 0.0023 was used between the minimum rate to the maximum rate to determine the numeric scaling. The numeric scaling for this example is presented in Table 1. Again, a unique numeric normalized scaling was created for every attribute within each category bin. The normalized scales for each attribute are presented in Appendix 2.

Rural Segment Bicyclists AADT Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.015	0.016	1
0.014	0.015	2
0.012	0.014	3
0.011	0.012	4
0.010	0.011	5
0.008	0.010	6
0.007	0.008	7
0.006	0.007	8
0.004	0.006	9
0.003	0.004	10

Table 1: Rural segment bicyclist AADT normalized scale.

Weighting

The primary reason for developing a weighting factor was to compare values across category bins. By including a weighting factor, a maximum composite score of 100 could be established for each of the eight categories. A secondary reason for building in a weighting factor was to ensure that in future iterations of this analysis, singular attributes could be emphasized over others, if desired. The value for each weight was simply calculated by dividing 100 (ultimately the maximum composite score desired) by the number of attributes in each category bin. This value was further divided by 10 because each attribute value had normalized scaling from 1-10. For example, in the bicycle rural segment category, seven attributes were analyzed. Since there were seven attributes and the desired composite score is 100, we divided 100 by seven to get 14.28. Since all attribute values were normalized to a common scale from 1-10, we further divide the 14.28 weight by 10 to reflect this scaling which ultimately makes the weight 1.428.

Composite Scoring

Once the weighting factor was defined for each category bin, they were then applied to the normalized value for each attribute by multiplying the normalized value by the weighting factor. The result is a weighted normalized score. In continuation of the example from prior sections, Figure 5 presents this process for rural bicycle segment AADT.

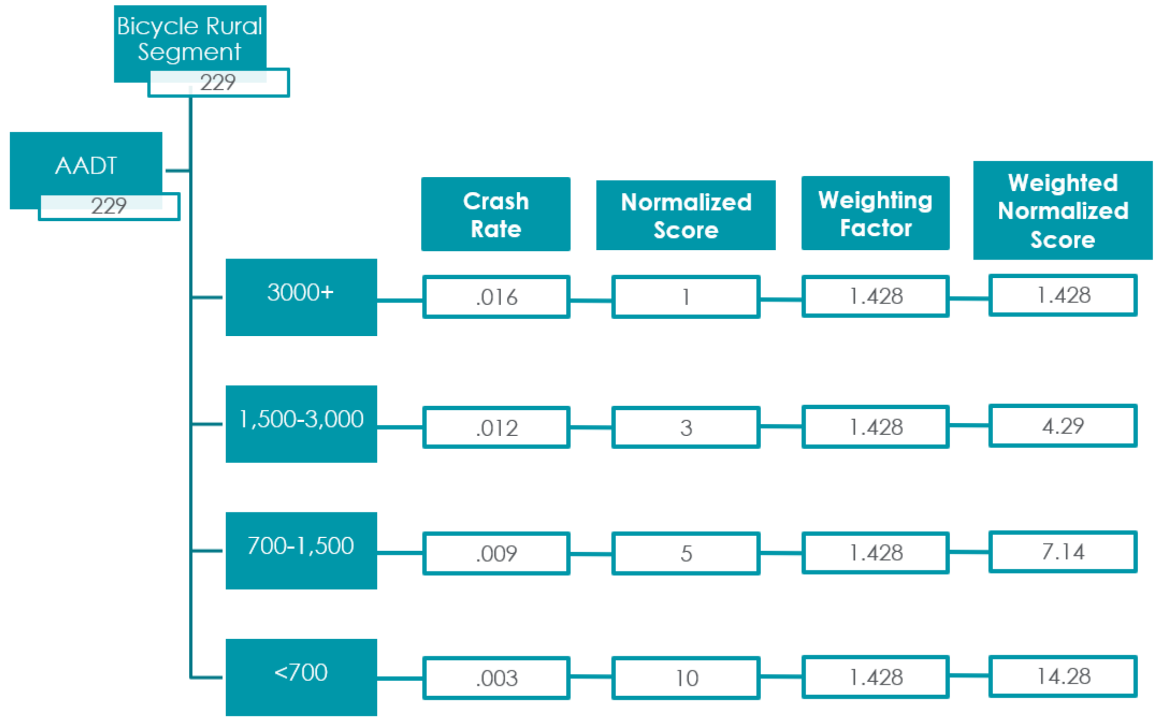

Figure 5: Example of Normalized Score, weighting factor, and weighted normalized score for bicycle rural segment AADT.

After a weighted normalized score is developed for all attributes, the final step is to calculate a composite score. The composite score is calculated by summing the weighted normalized score of each attribute for the segment or intersection. Please see Figure 6 for an example. The result is a composite score that, through an evaluation of the distinct attributes, emphasizes segments or intersections with a higher risk of crashes for pedestrians or bicyclists. The maximum composite score across all eight category bins is 100. In evaluating the composite score of the segments or intersections, the lower the composite score is the higher the risk.

Rural Segment Bicyclist	
Number of lanes	14.28
AADT	14.28
Shoulder Width	01.42
Shoulder Type	14.28
Shoulder Rumble	01.42
Speed Limit	10.00
Median Type	14.28
Composite Score	70.00

Figure 6: Example of overall composite scoring.

Results

As mentioned above, all paved roadways and intersections with at least two paved legs within Iowa were included in this analysis. This meant that over 46,000 miles of roadway and over 95,000 intersections were analyzed in this systemic safety analysis. Presented in Table 2 are summary statistics for the overall composite scoring. These statistics breakdown the composite score by the eight categorical bins defined previously in this analysis. As mentioned previously, Appendix 1 presents the breakdown of crashes, rates, and normalized values for all eight categorical bins used in this analysis. Further, Appendix 2 presents the normalized scales for each attribute for all eight categorical bins.

Category	Min	Max	Mean	Skewness
Rural Bike Segments	21.4	100.0	76.2	-1.2
Rural Pedestrian Segments	24.3	100.0	79.2	-.8
Urban Bike Segments	25.0	96.3	61.8	-1.3
Urban Pedestrian Segments	17.5	95	60.3	-0.8
Rural Bike Intersections	12.9	87.1	64.0	-0.5
Rural Pedestrian Intersections	20.0	87.1	60.2	0.02
Urban Bike Intersections	14.2	100.0	78.9	-1.8
Urban Pedestrian Intersections	22.3	100.0	83.8	-1.8

Table 2: Summary statistics for overall composite scoring.

Table 2 above provides an overall picture of the composite scoring for each of the categories examined in this analysis. This information is useful in understanding how a particular segment or intersection scores relative to its category. As mentioned previously, lower composite scores indicate higher risk and higher composite scores indicate lower risk. The composite score provides a useful numeric indicator to summarize the results of this systemic analysis, but it is important to also provide a description for each category of the attributes associated with the most risk. Similarities were found for bicyclists and pedestrians in the below categories, so their descriptions were combined.

Rural

The attributes found to have the most risk for bicyclists and pedestrians outside of incorporated limits were those with speed limits between 45-50 mph, a high number of lanes (4-5), and a median type which included hard surface without barriers. Risk was also associated with higher AADT (3000+ AADT) and areas where shoulder accommodations provided less than 2 feet and rumble strips were not present. For rural intersections higher risk for bicyclist and pedestrians were associated with four-legged intersections that had higher AADT (1500-3000+), entering speed limits between 45-50, and skew angles between 45-90 degrees. Higher risk was also associated with intersections that were signalized or had some level of control and those that had four or more lanes entering the intersections. Collectively, segments and intersections that are associated with these attributes are typically found just outside of incorporated areas in the transitional areas between rural driving environments and urban development. Even though the volume of bicyclists and pedestrians typically diminish as you move away from a downtown, a number of non-motorists might be found near these transitional areas to access multi-use trail heads that are often located just on the edge of incorporated areas. The presence of a bicyclist or pedestrian in these areas may be unexpected for drivers and thus poses a greater risk for both.

Urban

In urban or incorporated areas drivers are likely to be cognizant of the fact that pedestrians and bicyclists are more likely to be present in these areas because the frequencies of non-motorist are higher. It also means that there is more probability of conflicts as higher volumes of both non-motorist and vehicles exists in these areas. Additionally, the driving environment of these areas is more complex and visually taxing for drivers, therefore even though a driver may be expecting a pedestrian or bicyclist, they might not see them because of visual distraction or sight issues. For segments, the attributes associated with the highest risk for bicyclists and pedestrians in urban areas were roadways with speed limits between 25-35 mph, AADTs above 3000, and segments with more than five lanes. Diagonal parking and hard surface medians without barriers were also associated with higher risk in these areas. These roadway attributes are typically associated with commercial downtown areas in towns or cities. For urban intersections, higher risk for bicyclist and pedestrians were associated with intersections with five or more legs intersecting roadways or trails with AADT above 3000. Other attributes associated with higher risk were speed limits between 25-35 mph, entering roadways of 5 or more lanes, and intersection skew angles between 45-90 degrees.

Interactive Mapping

The summary statistics presented in Table 2 above and the detailed attribute information provided in both appendices serve as a high-level overview of the overall results of this analysis. However, the ultimate goal of this analysis was to develop a metric that identifies the estimated risk associated with every segment and intersection within Iowa. Therefore, as part of pursuing that goal, an important product of this analysis is an interactive map that allows users to visualize in a spatial format the relative risk for pedestrians and bicyclist for roadways and intersections of interest (please see Figure 7 below for an example of this output).

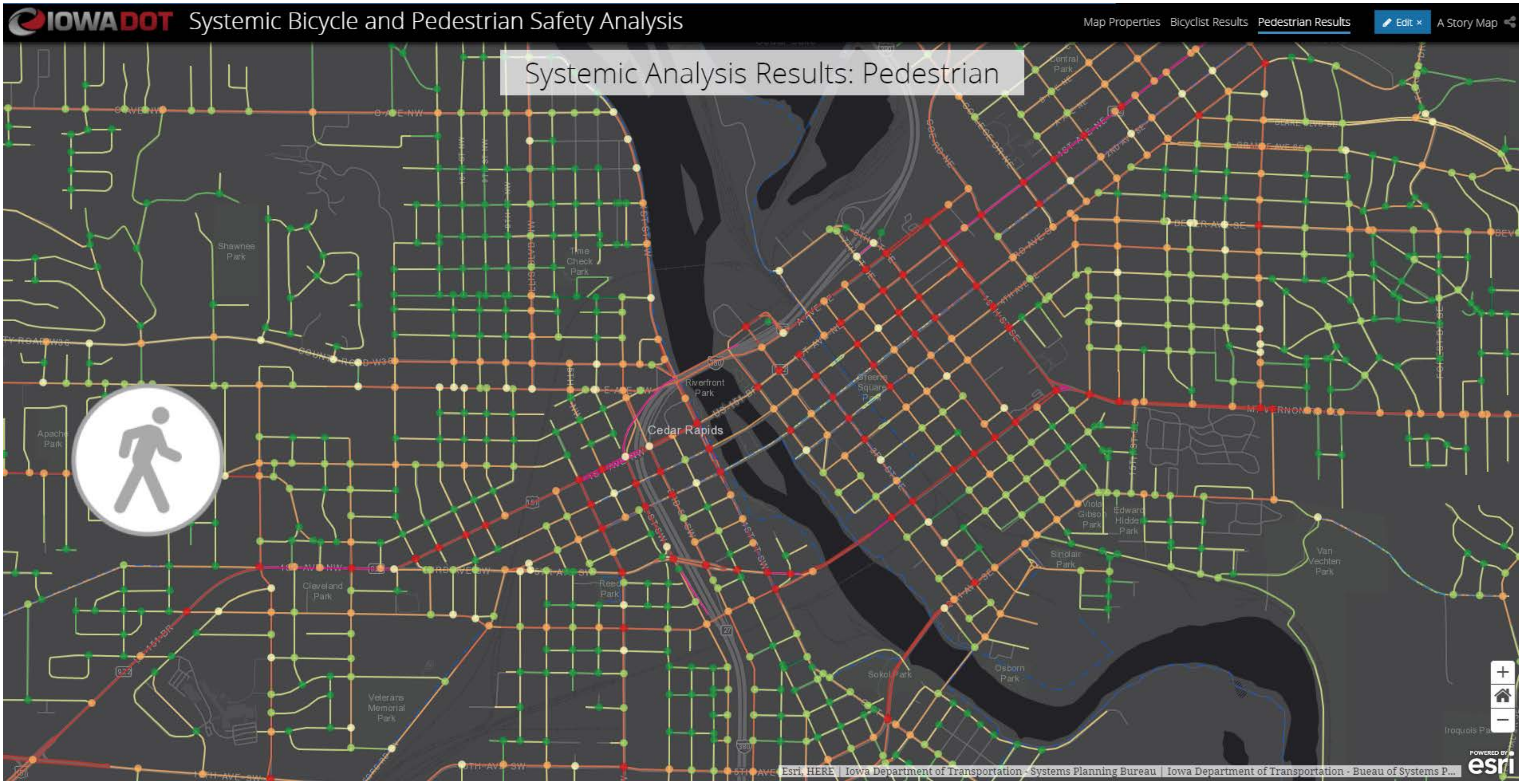

Figure 7: Interactive web map depicting the systemic analysis results for pedestrians.

Limitations to analysis

As with any analysis, there were certain aspects of this analysis that limited the completeness or accuracy of the outputs. The primary limitation was the completeness and accuracy of the data inputs, including the crash, roadway, and intersection data. Even though a limited number of attributes were used in the development of this analysis, it is understood that some values may not correctly reflect the segment or intersection as they exist today. This is a limitation most agencies accept when performing larger statewide screenings as it is not feasible to perform a quality check on every attribute for every data input.

A second limitation to this analysis was the iterative process of developing the final results. This first iteration of the analysis required several steps of processing, transforming, and synthesizing the data using multiple forms of software. As with all iterative processes, there are multiple opportunities where mistakes can occur. In future iterations of this analysis, an effort will be made to reduce the number of steps needed to achieve the final output.

A third limitation of this analysis is the composite scoring of some roadways and intersections that have inherent risk associated with them but high composite scores. For example, for a pedestrian or bicyclists a divided high-speed facility is inherently risky because of the speed and volume of traffic. In the analysis, these facilities often received high composite scores indicating less risk. The main reason is that this analysis was purely data driven. In the example of a divided facility, there are very few crashes involving a bicyclist or pedestrian (a major contributing reason for this is that bicyclists and pedestrians are not permitted on minimum speed facilities). Therefore, since very few crashes existed on these facilities and we have a good amount of mileage, these facilities received high composite scores indicating low risk.

The final limitation to note for this analysis relates to balanced weighting of all the attributes. While balanced weighting was preferred for this iteration, it is understood that some of the variables likely influence the risk of a crash occurring more than others. For example, speed is theoretically more likely to influence both the occurrence and severity of a non-motorist crash, which may suggest it should receive a higher weight.

Resources

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U.S. Census Bureau. American Community Survey, 2018 American Community Survey 5-Year Estimate, Table S0801. https://data.census.gov/cedsci/table?q=S0801&tid=ACSST5Y2018.S0801

Appendix 1

This appendix contains the breakdown of number of crashes, total mileage or intersection count, resulting rate, and normalized score for each attribute of all category bins within the analysis.

Rural Pedestrian Segments Attribute

AADT	Crashes	Segment Mileage	Rate	Normalized Score
0-700	61	13,926	0.004	10
701-1500	36	5,687	0.006	10
1501-3000	38	3,624	0.010	8
More than 3000	134	5,306	0.025	1

Median Type	Crashes	Segment Mileage	Rate	Normalized Score
Barrier	3	36	0.083	10
Grass Surface with Barrier	14	310	0.045	10
Grass Surface Without Barrier	41	3,148	0.013	10
Hard Surface Without Barrier	43	46	0.935	1
Null	168	24,995	0.007	10
Hard Surface with Barrier	0	7	0.000	10

Number of Lanes	Crashes	Segment Mileage	Rate	Normalized Score
1	2	478	0.004	8
2	258	27,504	0.009	5
3	8	499	0.016	2
4	1	54	0.019	1
5+	0	6	0.000	10

Shoulder Rumble	Crashes	Segment Mileage	Rate	Normalized Score
Present	54	3,261	0.017	1
Not Present	215	25,282	0.009	10

Shoulder Type	Crashes	Segment Mileage	Rate	Normalized Score
Combo Paved and Gravel	36	4,131	0.009	10
Earth	84	12,276	0.007	10
Gravel	55	9,509	0.006	10
NA	50	524	0.095	1
Paved	44	2,014	0.022	8
Combo Paved and Earth	0	10	0.000	10
Combo Paved and Paved	0	80	0.000	10

Shoulder Width	Crashes	Segment Mileage	Rate	Normalized Score
0-2	74	3,746	0.020	1
2-4	43	7,672	0.006	10
4+	152	17,032	0.009	8

Speed Limit	Crashes	Segment Mileage	Rate	Normalized Score
0-40	36	1,380	0.026	1
45-50	12	933	0.013	8
55-60	174	23,369	0.007	10
65+	47	2,862	0.016	6

Rural Bicyclists Segments Attribute

AADT	Crashes	Segment Mileage	Rate	Normalized Score
0-700	0-700	42	13926	0.003
701-1500	701-1500	56	5687	0.010
1501-3000	1501-3000	45	3624	0.012
More than 3000	More than 3000	86	5306	0.016

Median Type	Crashes	Segment Mileage	Rate	Normalized Score
Barrier	1	36	0.028	10
Grass Surface without Barrier	16	3,148	0.005	10
Hard Surface without Barrier	45	46	0.979	1
Null	167	24,995	0.007	10
Grass Surface with Barrier	0	310	0.000	10
Hard Surface with Barrier	0	7	0.000	10

Number of Lanes	Crashes	Segment Mileage	Rate	Normalized Score
1	1	478	0.002	10
2	218	27,504	0.008	10
3	6	499	0.012	10
4	3	54	0.056	7
5+	1	6	0.161	1

Shoulder Rumble	Crashes	Segment Mileage	Rate	Normalized Score
Present	18	3,261	0.006	10
Not Present	211	25,282	0.008	1

Shoulder Type	Crashes	Segment Mileage	Rate	Normalized Score
Paved	14	2,014	0.007	10
Earth	63	12,276	0.005	10
NA	47	524	0.090	1
Gravel	80	9,509	0.008	10
Combo Paved and Gravel	25	4,131	0.006	10
Combo Paved and Earth	0	10	0.000	10
Combo Paved and Paved	0	80	0.000	10

Shoulder Width	Crashes	Segment Mileage	Rate	Normalized Score
0-2	67	3,746	0.018	1
2-4	49	7,672	0.006	10
4+	113	16,927	0.007	10

Speed Limit	Crashes	Segment Mileage	Rate	Normalized Score
0-40	16	1,380	0.012	7
45-50	21	933	0.023	1
55-60	179	23,369	0.008	9
65+	13	2,862	0.005	10

Urban Pedestrian Segments

AADT	Crashes	Segment Mileage	Rate	Normalized Score
0-700	458	9,394	0.049	10
701-1500	378	2,954	0.128	8
1501-3000	298	1,614	0.185	6
More than 3000	1290	3,522	0.366	1

Median Type	Crashes	Segment Mileage	Rate	Normalized Score
Null	2214	15,829	0.140	8
Barrier	8	110	0.073	10
Grass Surface with Barrier	10	123	0.081	10
Grass Surface without Barrier	66	997	0.066	10
Hard Surface without Barrier	122	389	0.314	1
Hard Surface with Barrier	4	36	0.110	9

Number of Lanes	Crashes	Segment Mileage	Rate	Normalized Score
1	16	500	0.032	10
2	1760	15,780	0.112	10
3	192	610	0.315	8
4	358	512	0.700	5
5+	98	81	1.206	1

Parking Type	Crashes	Segment Mileage	Rate	Normalized Score
Null	74	1,370	0.054	10
Diagonal One Side - No Parking Other Side	12	39	0.305	5
Diagonal Both Sides	39	140	0.280	6
Diagonal Center - Parallel on Sides	3	6	0.542	1
No Parking is Posted	931	3,787	0.246	7
Parallel Both Sides	858	8,871	0.097	10
Parallel One Side - Diagonal Other Side	34	166	0.205	7
Parallel One Side - No Parking Other Side	470	3,068	0.153	8
Parallel or Diagonal on One Shoulder	1	4	0.234	7
Parallel or Diagonal on Both Shoulder	2	34	0.058	10

Shoulder Rumble	Crashes	Segment Mileage	Rate	Normalized Score
Present	22	452	0.049	10
Not Present	2402	17,032	0.141	1

Shoulder Type	Crashes	Segment Mileage	Rate	Normalized Score
Combo Paved and gravel	21	394	0.053	8
Earth	142	4,035	0.035	9
Gravel	74	1,297	0.057	8
Na	2125	10,878	0.195	1
Paved	62	838	0.074	7
Combo Paved and Earth	0	11	0.000	10
Combo Paved and Paved	0	31	0.000	10

Shoulder Width	Crashes	Segment Mileage	Rate	Normalized Score
0-2	2238	14,339	0.156	1
2-4	32	735	0.044	10
4+	154	2,386	0.065	9

Speed Limit	Crashes	Segment Mileage	Rate	Normalized Score
0-25	1514	12,786	0.118	8
26-35	715	1,980	0.361	1
36-50	123	1,037	0.119	8
51+	72	1,681	0.043	10

Urban Bicyclists Segments

AADT	Crashes	Segment Mileage	Rate	Normalized Score
0-700	286	9,394	0.030	10
701-1500	229	2,954	0.078	8
1501-3000	201	1,614	0.125	6
More than 3000	811	3,522	0.230	1

Median Type	Crashes	Segment Mileage	Rate	Normalized Score
Grass Surface with Barrier	1	123	0.008	10
Grass Surface without Barrier	45	997	0.045	8
Hard Surface with Barrier	2	36	0.055	7
Hard Surface without Barrier	61	389	0.157	1
Null	1418	15,829	0.090	5
Barrier	0	110	0.000	10

Number of Lanes	Crashes	Segment Mileage	Rate	Normalized Score
1	16	500	0.032	10
2	1059	15,780	0.067	10
3	126	610	0.206	8
4	260	512	0.508	4
5+	66	81	0.812	1

Parking Type	Crashes	Segment Mileage	Rate	Normalized Score
Diagonal Both Sides	20	140	0.143	7
Diagonal Center - Parallel on Sides	2	6	0.361	1
Diagonal One Side - No Parking Other Side	9	39	0.229	4
No Parking is Posted	590	3,787	0.156	6
Parallel Both Sides	492	8,871	0.055	9
Parallel One Side - Diagonal Other Side	26	166	0.156	6
Parallel One Side - No Parking Other Side	335	3,068	0.109	7
Null	53	1,370	0.039	9
Parallel or Diagonal on Both Shoulder	0	34	0.000	10
Parallel or Diagonal on One Shoulder	0	4	0.000	10

Shoulder Rumble	Crashes	Segment Mileage	Rate	Normalized Score
Present	2	452	0.004	10
Not Present	1525	17,032	0.090	1

Shoulder Type	Crashes	Segment Mileage	Rate	Normalized Score
Combo Paved and Gravel	7	11	0.617	1
Earth	88	4,035	0.022	10
Gravel	44	1,297	0.034	10
NA	1369	10,878	0.126	8
Paved	19	838	0.023	10
Combo Paved and Earth	0	11	0.000	10
Combo Paved and Paved	0	31	0.000	10

Shoulder Width	Crashes	Segment Mileage	Rate	Normalized Score
0-2	1426	14,339	0.099	1
2-4	29	735	0.039	9
4+	72	2,382	0.030	10

Speed Limit	Crashes	Segment Mileage	Rate	Normalized Score
0-25	983	12,786	0.077	8
26-35	453	1,980	0.229	1
36-50	55	1,037	0.053	9
51+	36	1,681	0.021	10

Rural Pedestrian Intersection

AADT	Crashes	Intersection Count	Rate	Normalized Score
0-700	3	17779	0.000168738	10
701-1500	4	5895	0.000678541	9
1501-3000	9	3041	0.002959553	1
More than 3000	7	2736	0.00255848	2

Intersection Angle	Crashes	Intersection Count	Rate	Normalized Score
0-45	0	2718	0	10
46-67	2	2018	0.00099108	1
68-89	1	4073	0.000245519	8
90	20	20533	0.000974042	1
91+	0	109	0	10

Intersection Traffic Control	Crashes	Intersection Count	Rate	Normalized Score
Signalized (with ped signal)	3	18	0.166666667	1
Signalized (without ped signal)	1	33	0.03030303	9
All-way Stop	1	251	0.003984064	10
Two-way Stop	8	11060	0.000723327	10
One-way Stop	10	15517	0.000644454	10
Railroad Crossing, Gates and Flashing Lights	0	1	0	10
Railroad Crossing, Stop-Sign Controlled	0	2	0	10
Yield Sign	0	287	0	10
Uncontrolled	0	2159	0	10
Other	0	66	0	10
Not Reported	0	57	0	10

Intersection Type	Crashes	Intersection Count	Rate	Normalized Score
Roadway (not interchange related)	22	27848	0.000790003	1
Roadway (interchange ramp terminal)	1	1582	0.000632111	2
Roadway/Bicycle Path or Trail	0	16	0	10
Roadway/Railroad Grade Crossing	0	5	0	10

Number of Lanes	Crashes	Intersection Count	Rate	Normalized Score
5+	1	19	0.052631579	1
4	1	188	0.005319149	9
3	3	1590	0.001886792	10
2	18	27568	0.000652931	10
1	0	86	0	10

Number of Legs	Crashes	Intersection Count	Rate	Normalized Score
3	10	17590	0.000568505	5
4	13	11848	0.001097232	1
5+	0	13	0	10

Speed Limit	Crashes	Intersection Count	Rate	Normalized Score
0-40	6	1493	0.004018754	1
45-50	1	653	0.001531394	7
55-60	16	26302	0.000608319	9
65+	0	1003	0	10

Rural Bicyclists Intersection

AADT	Crashes	Intersection Count	Rate	Normalized Score
More than 3000	13	2,736	0.005	1
1501-3000	5	3,041	0.002	8
701-1500	4	5,895	0.001	10
0-700	9	17,779	0.001	10

Intersection Type	Crashes	Intersection Count	Rate	Normalized Score
Roadway (not interchange related)	30	27,848	0.001	1
Roadway (interchange ramp terminal)	1	1,582	0.001	5
Roadway/Bicycle Path or Trail	0	16	0.000	10
Roadway/Railroad Grade Crossing	0	5	0.000	10

Intersection Traffic Control	Crashes	Intersection Count	Rate	Normalized Score
Signalized (with ped signal)	1	18	0.056	1
Signalized (without ped signal)	1	33	0.030	5
Not Reported	1	57	0.018	7
All-way Stop	1	251	0.004	10
Two-way Stop	14	11,060	0.001	10
One-way Stop	12	15,517	0.001	10
Uncontrolled	1	2,159	0.000	10
Railroad Crossing, Gates and Flashing Lights	0	1	0.000	10
Railroad Crossing, Stop-Sign Controlled	0	2	0.000	10
Yield Sign	0	287	0.000	10
Other	0	66	0.000	10

Intersection Angle	Crashes	Intersection Count	Rate	Normalized Score
0-45	0	2,718	0.000	10
46-67	3	2,018	0.001	1
68-89	6	4,073	0.001	1
90	22	20,533	0.001	3
91+	0	109	0.000	10

Number of Lanes	Crashes	Intersection Count	Rate	Normalized Score
1	0	86	0.000	10
2	23	27,568	0.001	10
3	6	1,590	0.004	10
4	1	188	0.005	9
5+	1	19	0.053	1

Number of Legs	Crashes	Intersection Count	Rate	Normalized Score
3	13	17,590	0.001	6
4	18	11,848	0.002	1
5+	0	13	0.000	10

Speed Limit	Crashes	Intersection Count	Rate	Normalized Score
0-40	5	1,493	0.003	6
45-50	5	653	0.008	1
55-60	21	26,302	0.001	9
65+	0	1,003	0.000	10

Urban Pedestrian Intersection

AADT	Crashes	Intersection Count	Rate	Normalized Score
0-700	70	43,319	0.002	10
701-1500	75	18,762	0.004	10
1501-3000	112	11,225	0.010	9
More than 3000	1331	16,901	0.079	1

Intersection Angle	Crashes	Intersection Count	Rate	Normalized Score
0-45	10	2,457	0.004	10
46-67	61	3,136	0.019	4
68-89	182	7,753	0.023	1
90	1330	76,458	0.017	5
90+	5	403	0.012	7

Intersection Traffic Control	Crashes	Intersection Count	Rate	Normalized Score
All-way Stop	122	3,392	0.036	10
Not Reported	3	4,176	0.001	10
One-way Stop	245	30,562	0.008	10
Other	11	468	0.024	10
Signalized (with ped signal)	727	1,884	0.386	1
Signalized (without ped signal)	101	690	0.146	7
Two-way Stop	322	21,054	0.015	10
Uncontrolled	40	22,815	0.002	10
Yield Sign	17	5,117	0.003	10
Railroad Crossing, Crossbucks Only	0	11	0.000	10
Railroad Crossing, Flashing Lights Only	0	16	0.000	10
Railroad Crossing, Gates and Flashing Lights	0	13	0.000	10
Railroad Crossing, Stop-Sign Controlled	0	9	0.000	10

Intersection Type	Crashes	Intersection Count	Rate	Normalized Score
Roadway (not interchange related)	1561	88,613	0.018	9
Roadway/bicycle path or trail	12	112	0.107	1
Roadway (interchange ramp terminal)	15	1,455	0.010	10
Roadway/Pedestrian Crossing	0	2	0.000	10
Roadway/Railroad Grade Crossing	0	23	0.000	10
Not Reported	0	2	0.000	10

Number of Lanes	Crashes	Intersection Count	Rate	Normalized Score
1	2	190	0.011	10
2	579	81,241	0.007	10
3	253	3,301	0.077	8
4	553	4,761	0.116	7
5+	201	714	0.282	1

Number of Legs	Crashes	Intersection Count	Rate	Normalized Score
3	388	53,246	0.007	10
4	1191	36,840	0.032	7
5+	9	118	0.076	1

Speed Limit	Crashes	Intersection Count	Rate	Normalized Score
0-25	702	69,313	0.010	10
26-35	767	13,138	0.058	1
36-50	89	3,140	0.028	6
51+	30	4,616	0.006	10

Urban Bicyclists Intersection

AADT	Crashes	Intersection Count	Rate	Normalized Score
0-700	129	43,319	0.003	10
701-1500	166	18,762	0.009	10
1501-3000	167	11,225	0.015	9
More than 3000	1,515	16,901	0.090	1

Intersection Angle	Crashes	Intersection Count	Rate	Normalized Score
0-45	27	2,457	0.011	10
46-67	103	3,136	0.033	1
68-89	212	7,753	0.027	3
90	1631	76,458	0.021	6
90+	4	403	0.010	10

Intersection Traffic Control	Crashes	Intersection Count	Rate	Normalized Score
All-way Stop	123	3,392	0.036	10
Not Reported	12	4,176	0.003	10
One-way Stop	396	30,562	0.013	10
Other	15	468	0.032	10
Railroad Crossing, Crossbucks Only	1	11	0.091	8
Railroad Crossing, Flashing Lights Only	2	16	0.125	7
Railroad Crossing, Stop-Sign Controlled	1	13	0.077	8
Signalized (with ped signal)	692	1,884	0.367	1
Signalized (without ped signal)	102	690	0.148	6
Two-way Stop	555	21,054	0.026	10
Uncontrolled	54	22,815	0.002	10
Yield Sign	24	5,117	0.005	10
Railroad Crossing, Gates and Flashing Lights	0	13	0.000	10

Intersection Type	Crashes	Intersection Count	Rate	Normalized Score
Roadway (not interchange related)	1931	88,613	0.022	4
Roadway/bicycle path or trail	4	112	0.036	1
Roadway (interchange ramp terminal)	42	1,455	0.029	2
Roadway/Pedestrian Crossing	0	2	0.000	10
Roadway/Railroad Grade Crossing	0	23	0.000	10
Not Reported	0	2	0.000	10

Number of Lanes	Crashes	Intersection Count	Rate	Normalized Score
1	6	190	0.032	10
2	884	81,241	0.011	10
3	352	3,301	0.107	7
4	553	4,761	0.116	6
5 +	182	714	0.255	1

Number of Legs	Crashes	Intersection Count	Rate	Normalized Score
3	523	53,246	0.010	10
4	1436	36,840	0.039	9
5+	18	118	0.153	1

Speed Limit	Crashes	Intersection Count	Rate	Normalized Score
0-25	803	69,313	0.012	10
26-35	946	13,138	0.072	1
36-50	153	3,140	0.049	4
51+	75	4,616	0.016	10

Appendix 2

Within this appendix, each attribute's normalized scaling is presented.

Rural Pedestrian Segments

AADT Normalized Scale

Min Rate	Max Rate	Normalized Score
0.023	0.025	1
0.021	0.023	2
0.019	0.021	3
0.017	0.019	4
0.015	0.017	5
0.013	0.015	6
0.011	0.013	7
0.009	0.011	8
0.006	0.009	9
0.004	0.006	10

Median Type Normalized Scale

Min Rate	Max Rate	Normalized Score
0.842	0.935	1
0.748	0.842	2
0.655	0.748	3
0.561	0.655	4
0.468	0.561	5
0.374	0.468	6
0.281	0.374	7
0.187	0.281	8
0.094	0.187	9
0.000	0.094	10

Number of Lanes Normalized Scale

Min Rate	Max Rate	Normalized Score
0.017	0.019	1
0.015	0.017	2
0.013	0.015	3
0.011	0.013	4
0.009	0.011	5
0.007	0.009	6
0.006	0.007	7
0.004	0.006	8
0.002	0.004	9
0.000	0.002	10

Shoulder Rumble Normalized Scale

Min Rate	Max Rate	Normalized Score
0.016	0.017	1
0.015	0.016	2
0.014	0.015	3
0.013	0.014	4
0.013	0.013	5
0.012	0.013	6
0.011	0.012	7
0.010	0.011	8
0.009	0.010	9
0.009	0.009	10

Shoulder Type Normalized Scale

Min Rate	Max Rate	Normalized Score
0.086	0.095	1
0.076	0.086	2
0.067	0.076	3
0.057	0.067	4
0.048	0.057	5
0.038	0.048	6
0.029	0.038	7
0.019	0.029	8
0.010	0.019	9
0.000	0.010	10

Shoulder Width Normalized Scale

Min Rate	Max Rate	Normalized Score
0.018	0.020	1
0.017	0.018	2
0.016	0.017	3
0.014	0.016	4
0.013	0.014	5
0.011	0.013	6
0.010	0.011	7
0.008	0.010	8
0.007	0.008	9
0.006	0.007	10

Speed Limit Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.024	0.026	1
0.022	0.024	2
0.020	0.022	3
0.019	0.020	4
0.017	0.019	5
0.015	0.017	6
0.013	0.015	7
0.011	0.013	8
0.009	0.011	9
0.007	0.009	10

Rural Bicyclist Segments

AADT Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.026	0.028	1
0.023	0.026	2
0.021	0.023	3
0.019	0.021	4
0.016	0.019	5
0.014	0.016	6
0.011	0.014	7
0.009	0.011	8
0.007	0.009	9
0.004	0.007	10

Median Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.881	0.979	1
0.783	0.881	2
0.685	0.783	3
0.587	0.685	4
0.489	0.587	5
0.391	0.489	6
0.294	0.391	7
0.196	0.294	8
0.098	0.196	9
0.000	0.098	10

Number of Lanes Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.146	0.161	1
0.130	0.146	2
0.114	0.130	3
0.098	0.114	4
0.082	0.098	5
0.066	0.082	6
0.050	0.066	7
0.034	0.050	8
0.018	0.034	9
0.002	0.018	10

Shoulder Rumble Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.0081	0.0083	1
0.0078	0.0081	2
0.0075	0.0078	3
0.0072	0.0075	4
0.0069	0.0072	5
0.0067	0.0069	6
0.0064	0.0067	7
0.0061	0.0064	8
0.0058	0.0061	9
0.0055	0.0058	10

Shoulder Type Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.081	0.090	1
0.072	0.081	2
0.063	0.072	3
0.054	0.063	4
0.045	0.054	5
0.036	0.045	6
0.027	0.036	7
0.018	0.027	8
0.009	0.018	9
0.000	0.009	10

Shoulder Width Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.017	0.018	1
0.016	0.017	2
0.014	0.016	3
0.013	0.014	4
0.012	0.013	5
0.011	0.012	6
0.010	0.011	7
0.009	0.010	8
0.008	0.009	9
0.006	0.008	10

Speed Limit Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.021	0.023	1
0.019	0.021	2
0.017	0.019	3
0.015	0.017	4
0.014	0.015	5
0.012	0.014	6
0.010	0.012	7
0.008	0.010	8
0.006	0.008	9
0.005	0.006	10

Urban Pedestrian Segments

AADT Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.334	0.366	1
0.303	0.334	2
0.271	0.303	3
0.239	0.271	4
0.208	0.239	5
0.176	0.208	6
0.144	0.176	7
0.112	0.144	8
0.081	0.112	9
0.049	0.081	10

Median Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.289	0.314	1
0.264	0.289	2
0.240	0.264	3
0.215	0.240	4
0.190	0.215	5
0.165	0.190	6
0.140	0.165	7
0.116	0.140	8
0.091	0.116	9
0.066	0.091	10

Number of Lanes Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
1.089	1.206	1
0.971	1.089	2
0.854	0.971	3
0.736	0.854	4
0.619	0.736	5
0.502	0.619	6
0.384	0.502	7
0.267	0.384	8
0.149	0.267	9
0.032	0.149	10

Parking Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.493	0.542	1
0.444	0.493	2
0.395	0.444	3
0.347	0.395	4
0.298	0.347	5
0.249	0.298	6
0.200	0.249	7
0.152	0.200	8
0.103	0.152	9
0.054	0.103	10

Shoulder Rumble Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.132	0.141	1
0.123	0.132	2
0.113	0.123	3
0.104	0.113	4
0.095	0.104	5
0.086	0.095	6
0.076	0.086	7
0.067	0.076	8
0.058	0.067	9
0.049	0.058	10

Shoulder Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.176	0.195	1
0.156	0.176	2
0.137	0.156	3
0.117	0.137	4
0.098	0.117	5
0.078	0.098	6
0.059	0.078	7
0.039	0.059	8
0.020	0.039	9
0.000	0.020	10

Shoulder Width Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.145	0.156	1
0.134	0.145	2
0.122	0.134	3
0.111	0.122	4
0.100	0.111	5
0.089	0.100	6
0.077	0.089	7
0.066	0.077	8
0.055	0.066	9
0.044	0.055	10

Speed Limit Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.329	0.361	1
0.297	0.329	2
0.266	0.297	3
0.234	0.266	4
0.202	0.234	5
0.170	0.202	6
0.138	0.170	7
0.106	0.138	8
0.075	0.106	9
0.043	0.075	10

Urban Bicyclist Segments

AADT Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.210	0.230	1
0.190	0.210	2
0.170	0.190	3
0.150	0.170	4
0.130	0.150	5
0.110	0.130	6
0.090	0.110	7
0.070	0.090	8
0.050	0.070	9
0.030	0.050	10

Median Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.141	0.157	1
0.126	0.141	2
0.110	0.126	3
0.094	0.110	4
0.078	0.094	5
0.063	0.078	6
0.047	0.063	7
0.031	0.047	8
0.016	0.031	9
0.000	0.016	10

Number of Lanes Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.734	0.812	1
0.656	0.734	2
0.578	0.656	3
0.500	0.578	4
0.422	0.500	5
0.344	0.422	6
0.266	0.344	7
0.188	0.266	8
0.110	0.188	9
0.032	0.110	10

Parking Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.325	0.361	1
0.289	0.325	2
0.253	0.289	3
0.217	0.253	4
0.181	0.217	5
0.144	0.181	6
0.108	0.144	7
0.072	0.108	8
0.036	0.072	9
0.000	0.036	10

Shoulder Rumble Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.081	0.090	1
0.073	0.081	2
0.064	0.073	3
0.055	0.064	4
0.047	0.055	5
0.038	0.047	6
0.030	0.038	7
0.021	0.030	8
0.013	0.021	9
0.004	0.013	10

Shoulder Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.556	0.617	1
0.494	0.556	2
0.432	0.494	3
0.370	0.432	4
0.309	0.370	5
0.247	0.309	6
0.185	0.247	7
0.123	0.185	8
0.062	0.123	9
0.000	0.062	10

Shoulder Width Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.093	0.099	1
0.086	0.093	2
0.079	0.086	3
0.072	0.079	4
0.065	0.072	5
0.058	0.065	6
0.051	0.058	7
0.044	0.051	8
0.037	0.044	9
0.030	0.037	10

Speed Limit Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.208	0.229	1
0.187	0.208	2
0.167	0.187	3
0.146	0.167	4
0.125	0.146	5
0.104	0.125	6
0.084	0.104	7
0.063	0.084	8
0.042	0.063	9
0.021	0.042	10

Rural Pedestrian Intersections

AADT Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.0027	0.0030	1
0.0024	0.0027	2
0.0021	0.0024	3
0.0018	0.0021	4
0.0016	0.0018	5
0.0013	0.0016	6
0.0010	0.0013	7
0.0007	0.0010	8
0.0004	0.0007	9
0.0002	0.0004	10

Intersection Angle Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.0009	0.0010	1
0.0008	0.0009	2
0.0007	0.0008	3
0.0006	0.0007	4
0.0005	0.0006	5
0.0004	0.0005	6
0.0003	0.0004	7
0.0002	0.0003	8
0.0001	0.0002	9
0.0000	0.0001	10

Inter Traffic Control Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.150	0.167	1
0.133	0.150	2
0.117	0.133	3
0.100	0.117	4
0.083	0.100	5
0.067	0.083	6
0.050	0.067	7
0.033	0.050	8
0.017	0.033	9
0.000	0.017	10

Intersection Type Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.0007	0.0008	1
0.0006	0.0007	2
0.0006	0.0006	3
0.0005	0.0006	4
0.0004	0.0005	5
0.0003	0.0004	6
0.0002	0.0003	7
0.0002	0.0002	8
0.0001	0.0002	9
0.0000	0.0001	10

Number of Lanes Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.047	0.053	1
0.042	0.047	2
0.037	0.042	3
0.032	0.037	4
0.026	0.032	5
0.021	0.026	6
0.016	0.021	7
0.011	0.016	8
0.005	0.011	9
0.000	0.005	10

Number of Legs Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.0010	0.0011	1
0.0009	0.0010	2
0.0008	0.0009	3
0.0007	0.0008	4
0.0005	0.0007	5
0.0004	0.0005	6
0.0003	0.0004	7
0.0002	0.0003	8
0.0001	0.0002	9
0.0000	0.0001	10

Speed Limit Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.0036	0.0040	1
0.0032	0.0036	2
0.0028	0.0032	3
0.0024	0.0028	4
0.0020	0.0024	5
0.0016	0.0020	6
0.0012	0.0016	7
0.0008	0.0012	8
0.0004	0.0008	9
0.0000	0.0004	10

Rural Bicyclist Intersections

AADT Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.0043	0.0048	1
0.0039	0.0043	2
0.0035	0.0039	3
0.0031	0.0035	4
0.0026	0.0031	5
0.0022	0.0026	6
0.0018	0.0022	7
0.0014	0.0018	8
0.0009	0.0014	9
0.0005	0.0009	10

Intersection Angle Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.0013	0.0015	1
0.0012	0.0013	2
0.0010	0.0012	3
0.0009	0.0010	4
0.0007	0.0009	5
0.0006	0.0007	6
0.0004	0.0006	7
0.0003	0.0004	8
0.0001	0.0003	9
0.0000	0.0001	10

Inter Traffic Control Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.050	0.056	1
0.044	0.050	2
0.039	0.044	3
0.033	0.039	4
0.028	0.033	5
0.022	0.028	6
0.017	0.022	7
0.011	0.017	8
0.006	0.011	9
0.000	0.006	10

Intersection Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.0010	0.0011	1
0.0009	0.0010	2
0.0008	0.0009	3
0.0006	0.0008	4
0.0005	0.0006	5
0.0004	0.0005	6
0.0003	0.0004	7
0.0002	0.0003	8
0.0001	0.0002	9
0.0000	0.0001	10

Number of Lanes Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.047	0.053	1
0.042	0.047	2
0.037	0.042	3
0.032	0.037	4
0.026	0.032	5
0.021	0.026	6
0.016	0.021	7
0.011	0.016	8
0.005	0.011	9
0.000	0.005	10

Number of Legs Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.0014	0.0015	1
0.0012	0.0014	2
0.0011	0.0012	3
0.0009	0.0011	4
0.0008	0.0009	5
0.0006	0.0008	6
0.0005	0.0006	7
0.0003	0.0005	8
0.0002	0.0003	9
0.0000	0.0002	10

Speed Limit Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.0069	0.0077	1
0.0061	0.0069	2
0.0054	0.0061	3
0.0046	0.0054	4
0.0038	0.0046	5
0.0031	0.0038	6
0.0023	0.0031	7
0.0015	0.0023	8
0.0008	0.0015	9
0.0000	0.0008	10

Urban Pedestrian Intersections

AADT Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.071	0.079	1
0.063	0.071	2
0.056	0.063	3
0.048	0.056	4
0.040	0.048	5
0.032	0.040	6
0.025	0.032	7
0.017	0.025	8
0.009	0.017	9
0.002	0.009	10

Intersection Angle Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.022	0.023	1
0.020	0.022	2
0.018	0.020	3
0.016	0.018	4
0.014	0.016	5
0.012	0.014	6
0.010	0.012	7
0.008	0.010	8
0.006	0.008	9
0.022	0.023	10

Inter Traffic Control Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.347	0.386	1
0.309	0.347	2
0.270	0.309	3
0.232	0.270	4
0.193	0.232	5
0.154	0.193	6
0.116	0.154	7
0.077	0.116	8
0.039	0.077	9
0.000	0.039	10

Intersection Type Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.096	0.107	1
0.086	0.096	2
0.075	0.086	3
0.064	0.075	4
0.054	0.064	5
0.043	0.054	6
0.032	0.043	7
0.021	0.032	8
0.011	0.021	9
0.000	0.011	10

Number of Lanes Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.254	0.282	1
0.227	0.254	2
0.199	0.227	3
0.172	0.199	4
0.144	0.172	5
0.117	0.144	6
0.089	0.117	7
0.062	0.089	8
0.035	0.062	9
0.007	0.035	10

Number of Legs Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.069	0.076	1
0.062	0.069	2
0.056	0.062	3
0.049	0.056	4
0.042	0.049	5
0.035	0.042	6
0.028	0.035	7
0.021	0.028	8
0.014	0.021	9
0.007	0.014	10

Speed Limit Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.053	0.058	1
0.048	0.053	2
0.043	0.048	3
0.038	0.043	4
0.032	0.038	5
0.027	0.032	6
0.022	0.027	7
0.017	0.022	8
0.012	0.017	9
0.006	0.012	10

Urban Bicyclist Intersections

AADT Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.081	0.090	1
0.072	0.081	2
0.064	0.072	3
0.055	0.064	4
0.046	0.055	5
0.038	0.046	6
0.029	0.038	7
0.020	0.029	8
0.012	0.020	9
0.003	0.012	10

Intersection Angle Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.031	0.033	1
0.028	0.031	2
0.026	0.028	3
0.024	0.026	4
0.021	0.024	5
0.019	0.021	6
0.017	0.019	7
0.015	0.017	8
0.012	0.015	9
0.010	0.012	10

Inter Traffic Control Normalized Scale		
Min Rate	Max Rate	Normalized Score
0.331	0.367	1
0.294	0.331	2
0.257	0.294	3
0.220	0.257	4
0.184	0.220	5
0.147	0.184	6
0.110	0.147	7
0.073	0.110	8
0.037	0.073	9
0.000	0.037	10

Intersection Type Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.032	0.036	1
0.029	0.032	2
0.025	0.029	3
0.021	0.025	4
0.018	0.021	5
0.014	0.018	6
0.011	0.014	7
0.007	0.011	8
0.004	0.007	9
0.000	0.004	10

Number of Lanes Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.230	0.255	1
0.206	0.230	2
0.182	0.206	3
0.157	0.182	4
0.133	0.157	5
0.108	0.133	6
0.084	0.108	7
0.060	0.084	8
0.035	0.060	9
0.011	0.035	10

Number of Legs Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.138	0.153	1
0.124	0.138	2
0.110	0.124	3
0.095	0.110	4
0.081	0.095	5
0.067	0.081	6
0.053	0.067	7
0.038	0.053	8
0.024	0.038	9
0.010	0.024	10

Speed Limit Normalized Scale		
Min Rate	**Max Rate**	**Normalized Score**
0.066	0.072	1
0.060	0.066	2
0.054	0.060	3
0.048	0.054	4
0.042	0.048	5
0.036	0.042	6
0.030	0.036	7
0.024	0.030	8
0.018	0.024	9
0.012	0.018	10