An Implementation Framework for Random Parameter Models for Crash Frequency Prediction and Safety Investment Prioritization on the Washington State DOT Highway Network

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16. Abstract

The Washington State Department of Transportation (WSDOT) highway network is comprised of multiple functional classes, ranging from two-lane rural to two-lane urban, interstate, and other classes. This study focused on developing a framework for implementing random parameter models of annual crash frequency for these roadway classes. The implementation framework includes statistical models developed for the two-year period 2014-2015 at the 1-mile scale, and a web-based interface that embeds the 1-mile models in a user-friendly manner. The objective of the web-based interface is to provide to decision makers a facility to evaluate the impact of changes in geometric attributes on predicted crash counts for any segment on the WSDOT highway network. The total number of segments for each functional class is defined by 1-mile segment counts. A 1-mile segmentation scale was used to ensure project-level consistency with decisions arising from a random parameter statistical model. In the literature, a variety of segmentations have been analyzed—from homogeneous segments (which can be as small as 0.01 miles) to segmentation that includes homogeneous segments with respect to curvature, to segmentation that is fixed-length in nature (for example, 1 mile). The 1-mile segmentation provides the facility to analyze the impact of corridor-level safety investments. This is done due to the fact that heterogeneity in the corridors is addressed at a higher scale than the typical homogeneous segment scale. The 1-mile scale also enables compatibility with network screening methods that are widely used in the application of the *Highway Safety Manual* (HSM). A demonstration of the implementation framework is presented in the form of a dashboard system. The demonstration system provides the opportunity to explore enhancements to maximize its utility. Recommendations include soliciting input to leverage the rich information in safety models when planning infrastructure improvements; examining other modelling approaches such as ensemble models to incorporate a larger set of attributes and enable more robust investigations of attribute changes on expected crash rates; utilizing the system's scalability to incorporate yearly models; and incorporating real-time monitoring of crashes into the system to enable notification to practitioners when current crash rates exceed predicted values so potential problems can be addressed in a timely fashion.

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AN IMPLEMENTATION FRAMEWORK FOR RANDOM PARAMETER MODELS FOR CRASH FREQUENCY PREDICTION AND SAFETY INVESTMENT PRIORITIZATION ON THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION HIGHWAY NETWORK

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Table of Contents

1. Introduction 1
2. Data description and assembly 6
3. Random parameter modeling results 8
4. Implementation framework for random parameter models 10
   4.1 Goals and Challenges 10
   4.2 Alternative Designs for Implementation 10
   4.3 Requirements for Views for Web-Based System 11
   4.4 File Structure 11
   4.5 External Resources 12
5. Demonstration of implementation framework 13
   5.1 Route View 13
   5.2 Driver's View 17
   5.3 Segment Analysis View 18
6. Conclusions and recommendations 22
   6.1 Functionality of web based implementation framework 24

List of Tables

Table 1.1 Summary descriptive statistics of 1-mile fixed-length segments for all functional classes 1
Table 2.1 Variable types and data elements assembled for fixed-length segmentation models..... 7
Table 2.2. Continuous data elements for the seven variable types..... 7
Table 2.3 Descriptive statistic of crash counts..... 8
Table 3.1 Random parameter occurrence of total crash models for 1-mile segments..... 8
Table 3.2 Random parameter occurrence of property damage only crash models for 1-mile segments..... 9
Table 3.3 Random parameter occurrence of possible injury crash models for 1-mile segments. 9
Table 3.4 Random parameter occurrence of evident injury crash models for 1-mile segments..... 9
Table 3.5 Random parameter occurrence of serious injury crash models for 1-mile segments. 9
Table 3.6 Random parameter occurrence of fatal crash models for 1-mile segments..... 10
Table 6.1 Summary of fixed-length random parameter models for total crash frequency..... 23

List of Figures

Figure 5.1: Initial dashboard screen 13
Figure 5.2: The Route View after a route has been selected 14
Figure 5.3: Map functionality in Route View 14
Figure 5.4: Maps API-provided functionality. From left to right, these include satellite imagery with or without map labels; a map display with or without terrain; full screen mode; zoom controls; and street-level view 15
Figure 5.5: Additional functionality for the histogram 15
Figure 5.6: Pop-up menus for the map (left) and histogram (right) in the Route View 17
Figure 5.7: In the Driver's View, in addition to selecting a route and the beginning/ending ARM's, users may specify the direction of travel in the view 17
Figure 5.8: The Driver's View in the dashboard 18
Figure 5.9: The controls for the Segment Analysis View in the dashboard 19
Figure 5.10: The Alter Segment box in the Segment Analysis View after an attribute has been selected 19
Figure 5.11: The Alter Segment box in the Segment Analysis View showing the effect of a new attribute value on the predicted annual crash rate 20
Figure 5.12: Summary statistics for the functional class of the chosen segment in the Segment Analysis View 21
Figure 5.13: Parameter values for the functional class of the chosen segment in the Segment Analysis View 22

List of Appendices

Appendix A 25
Table A.1 Summary descriptive statistics of 0.5-mile fixed-length segments for all functional classes 26
Table A.2 Summary descriptive statistics of 0.25-mile fixed-length segments for all functional classes.. 31

Appendix B 36
Table B.1 Descriptive statistics of significant variables for 1-mile fixed-length segment models. 37
Table B.2 Descriptive statistics of significant variables for 0.5-mile fixed-length segment model 42
Table B.3 Descriptive statistics of significant variables for 0.25-mile fixed-length segment model 47

Appendix C 52
Table C.1 Random parameter occurrence of total crash models for 0.5-mile segments. 53
Table C.2 Random parameter occurrence of property damage only crash models for 0.5-mile segments 53
Table C.3 Random parameter occurrence of possible injury crash models for 0.5-mile segments 53
Table C.4 Random parameter occurrence of evident injury crash models for 0.5-mile segments. 53
Table C.5 Random parameter occurrence of serious injury crash models for 0.5-mile segments. 54
Table C.6 Random parameter occurrence of fatal crash models for 0.5-mile segments. 54
Table C.7 Random parameter occurrence of total crash models for 0.25-mile segments. 55
Table C.8 Random parameter occurrence of property damage only crash models for 0.25-mile segments. 55
Table C.9 Random parameter occurrence of possible injury crash models for 0.25-mile segments 55
Table C.10 Random parameter occurrence of evident injury crash models for 0.25-mile segments. 55
Table C.11 Random parameter occurrence of serious injury crash models for 0.25-mile segments. 56
Table C.12 Random parameter occurrence of fatal crash models for 0.25-mile segments. 56
Table C.13 Total crash models by functional classes for 1-mile segments 57
Table C.14 Property damage only crash models by functional classes for 1-mile segments. 63
Table C.15 Possible injury crash models by functional classes for 1-mile segment 69
Table C.16 Evident injury crash models by functional classes for 1-mile segment 74
Table C.17 Serious injury crash models by functional classes for 1-mile segment 78
Table C.18 Fatal crash models by functional classes for 1-mile segment 80
Table C.19 Total crash models by functional classes for 0.5-mile segments 82
Table C.20 Property damage only crash models by functional classes for 0.5-mile segments. 89
Table C.21 Possible injury crash models by functional classes for 0.5-mile segments. 96
Table C.22 Evident injury crash models by functional classes for 0.5-mile segments. 101
Table C.23 Serious injury crash models by functional classes for 0.5-mile segments 105

Table C.24 Fatal crash models by functional classes for 0.5-mile segments. 107
Table C.25 Total crash models by functional classes for 0.25-mile segments..... 109
Table C.26 Property damage only crash models by functional classes for 0.25-mile segments. 115
Table C.27 Possible injury crash models by functional classes for 0.25-mile segments. 121
Table C.28 Evident injury crash models by functional classes for 0.25-mile segments. 126
Table C.29 Serious injury crash models by functional classes for 0.25-mile segments..... 130
Table C.30 Fatal crash models by functional classes for 0.25-mile segments. 132

1. Introduction

The Washington State Department of Transportation (WSDOT) highway network is comprised of multiple functional classes, ranging from two-lane rural, to two-lane urban, interstate, and other classes. This study is focused on developing a framework for implementing random parameter models of annual crash frequency for these roadway classes. The implementation framework includes statistical models developed for the two-year period 2014-2015 at the 1-mile scale, and a web-based interface that embeds the 1-mile models in a user-friendly manner. The objective of the web-based interface is to provide to decision makers a facility to evaluate the impact of changes in geometric attributes on predicted crash counts for any segment on the WSDOT highway network. To the authors' knowledge, a systematic framework that includes "what-if" scenario capability using random parameter models is not established in the literature. Table 1.1 shows the descriptive statistics for the 1-mile segment network for the entire state.

Table 1.1 Summary descriptive statistics of 1-mile fixed-length segments for all functional classes

	Functional Class				
Route	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
2	230	7	57	28	0
3	38	3	0	19	0
4	55	0	1	6	0
5	0	0	0	0	277
6	51	0	0	0	0
7	40	4	0	14	0
8	0	0	21	0	0
9	52	26	0	11	0
10	16	0	0	0	0
11	19	1	0	0	0
12	261	0	42	21	0
14	161	4	0	15	0
16	0	0	3	24	0
17	124	2	2	7	0
18	6	0	4	18	0
19	13	0	0	0	0
20	363	17	5	10	0
21	179	0	0	0	0
22	32	3	1	0	0
23	66	0	0	0	0
24	72	5	0	2	0
25	121	0	0	0	0
26	133	1	0	0	0
27	80	2	1	5	0
28	112	17	0	6	0
31	27	0	0	0	0
41	0	0	1	0	0
82	0	0	0	0	132
90	0	0	0	0	297
92	0	7	0	1	0

Table 1.1 (Continued) Summary descriptive statistics of 1-mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
96	0	3	0	3	0
97	228	0	17	4	0
99	0	0	0	48	0
100	5	0	0	0	0
101	315	7	30	13	0
103	16	0	0	0	0
104	23	2	2	4	0
105	45	1	0	2	0
106	20	0	0	0	0
107	8	0	0	0	0
108	11	0	1	0	0
109	36	4	0	0	0
110	3	0	0	0	0
112	61	0	0	0	0
113	10	0	0	0	0
115	2	0	0	0	0
116	6	0	0	0	0
117	0	0	0	0	0
119	9	0	0	0	0
121	7	0	0	0	0
122	8	0	0	0	0
123	16	0	0	0	0
124	42	2	1	0	0
125	16	3	2	3	0
127	27	0	0	0	0
128	0	0	0	0	0
129	36	4	0	1	0
131	2	0	0	0	0
141	26	0	0	0	0
142	35	0	0	0	0
150	11	0	0	0	0
153	31	0	0	0	0
155	78	0	0	0	0
160	4	3	0	0	0
161	16	0	0	14	0
162	0	16	0	1	0
163	0	0	0	3	0
164	7	6	0	1	0
165	16	3	0	0	0
166	0	3	0	2	0
167	0	0	0	28	0

Table 1.1 (Continued) Summary descriptive statistics of 1-mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
169	7	8	2	7	0
170	3	0	1	0	0
171	0	1	0	2	0
172	35	0	0	0	0
173	12	0	0	0	0
174	40	0	1	0	0
181	0	0	0	6	0
182	0	0	0	0	15
193	2	0	0	0	0
194	14	0	0	0	0
195	75	0	14	3	0
197	1	0	1	0	0
202	15	9	1	5	0
203	21	2	1	0	0
204	0	1	0	1	0
205	0	0	0	0	11
206	13	2	0	0	0
207	4	0	0	0	0
211	15	0	0	0	0
213	1	0	0	0	0
215	6	0	0	0	0
221	26	0	0	0	0
223	4	0	0	0	0
224	6	0	0	3	0
225	11	0	0	0	0
231	72	0	0	0	0
240	22	5	0	12	0
241	23	2	0	0	0
243	28	0	0	0	0
260	38	0	0	0	0
261	56	0	0	0	0
262	20	0	0	0	0
263	9	0	0	0	0
270	2	0	3	5	0
271	8	0	0	0	0
272	19	0	0	0	0
274	2	0	0	0	0
278	3	0	0	0	0
281	9	0	1	0	0
282	4	1	0	0	0
283	14	0	1	0	0

Table 1.1 (Continued) Summary descriptive statistics of 1-mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
285	0	0	0	5	0
290	0	5	1	12	0
291	15	3	0	5	0
292	6	0	0	0	0
300	3	0	0	0	0
302	10	4	0	3	0
303	0	0	0	9	0
304	0	0	0	3	0
305	3	8	0	1	0
307	3	1	1	0	0
308	0	2	0	1	0
310	0	0	0	2	0
395	94	1	76	16	0
397	1	14	0	6	0
401	11	0	1	0	0
405	0	0	0	0	30
409	3	0	1	0	0
410	89	10	0	8	0
411	7	6	0	0	0
432	3	2	0	4	0
433	0	0	0	1	0
500	0	11	0	11	0
501	3	8	2	1	0
502	1	3	2	0	0
503	44	3	0	6	0
504	52	0	0	0	0
505	19	0	0	0	0
506	10	0	1	0	0
507	38	3	0	2	0
508	31	1	1	0	0
509	0	12	0	15	0
510	6	4	1	2	0
512	0	0	0	12	0
513	0	0	0	3	0
515	0	0	0	7	0
516	0	3	0	13	0
518	0	0	0	3	0
519	0	0	0	1	0
520	0	0	0	13	0
522	0	3	0	21	0
523	0	0	0	1	0

Table 1.1 (Continued) Summary descriptive statistics of 1-mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
524	0	7	0	8	0
525	19	2	2	7	0
526	0	0	0	4	0
527	0	0	0	9	0
528	0	0	0	3	0
529	0	0	0	7	0
530	48	1	0	0	0
531	5	3	1	0	0
532	9	0	1	0	0
534	4	0	1	0	0
536	2	2	0	1	0
538	0	0	0	3	0
539	3	1	7	4	0
542	52	3	1	1	0
543	1	0	0	0	0
544	9	0	0	0	0
546	8	0	0	0	0
547	10	0	0	0	0
548	8	5	1	0	0
599	0	0	0	1	0
702	8	0	1	0	0
704	0	0	0	1	0
705	0	0	0	0	1
706	14	0	0	0	0
730	6	0	0	0	0
821	23	1	1	0	0
823	0	1	0	4	0
900	0	5	2	7	0
902	12	0	0	0	0
903	10	0	0	0	0
904	13	1	1	2	0
906	3	0	0	0	0
970	10	0	0	0	0
971	10	0	0	0	0
Total	4,806	362	323	607	763
Total length (miles)	4,808.16	361.18	321.66	611.1	763.83

As seen in Table 1.1, the total number of segments for each functional class is defined by 1-mile segment counts. The 1-mile segment counts are typically contiguous segments. A 1-mile segmentation scale was used to ensure project-level consistency with decisions arising from a random parameter statistical model. In the literature, a variety of segmentations have been analyzed – from homogeneous segments (which can be as small as 0.01 miles) to segmentation that includes homogeneous segments with respect to curvature,

to segmentation that is fixed-length in nature (for example, 1 mile). The 1-mile segmentation provides the facility to analyze the impact of corridor-level safety investments. This is done due to the fact that heterogeneity in the corridors is addressed at a higher scale than the typical homogeneous segment scale. Second, the 1-mile scale also enables compatibility with network screening methods that are widely used in the application of the highway safety manual (HSM).

As observed in Table 1.1, the two-lane rural network used in our implementation framework totals 4,806 miles consisting of 4,806 segments. Another 362 segments constitute the two-lane urban network, while 763 segments constitute the interstate network. The remaining functional classes are defined collectively as non-two-lane-non-interstate urban and non-two-lane-non-interstate rural, respectively. These two classes collectively are comprised of 930 segments. In total, the network coverage totals 6,861 segments covering 6,865.93 miles. This reflects a 95.2 percentage usage of the available network. About 4.8 percent of the network was not used because of incomplete roadway information. Therefore, the used portion of the network includes complete geometric information on shoulder width, number of lanes, curvature, volume, pavement type, median treatment, and median type. The total mileage used in the modeling in this study reflects the fact that the last segment is not exactly 1 mile long.

The 1-mile segmentation also requires a different approach to the measurement of roadway geometrics. Since geometrics can vary over 1 mile, we use weighted averages of the geometric variables. In addition, we also assembled variables measuring the frequency of geometric variables occurring over 1 mile (such as count of vertical curves or horizontal curves).

To evaluate scale-specific effects with respect to heterogeneity, we also estimate random parameter models at the 0.5-mile and 0.25-mile segment scales. Descriptive statistics of the 0.5-mile segment network are shown in Table A.1 (in Appendix A). As shown in Table A.1, the number of segments is not exactly double the number used in the 1-mile network. This is because small discontinuities in functional classification result in loss of segment coverage as the scale is shortened. For the 1-mile segmentation models, we assumed a 90% functional class threshold to define if a segment belonged to a particular functional class.

Table A.2 shows the 0.25-mile segmentation network broken down by functional classes. The number of segments is roughly four times that used for the 1-mile segmentation network. This allows for a larger sample size for statistical model development on the one hand; on the other hand, it also poses limitations in usability of the model for project-level decisions.

2. Data description and assembly

Table 2.1 shows the variable types and associated data elements that were available after segmentation of the raw state highway network data into fixed-length segments. Seven major variable types were identified and assembled through multiple data elements for each type. The seven variable types were ADT, horizontal curvature, vertical curvature, travel lane, roadway, travel shoulder, and median. As is shown in the table, a variety of data elements were constructed for the seven variable types. The construction of this detailed set of data elements provided the basis for comprehensive random parameter model specification. This ensured that the correct random parameters were identified, by limiting potential omitted variable effects.

Table 2.2 shows the summary of variable categories developed and used in the random parameter model estimations. The variable categories are common to the various functional classes and scales (1-mile, 0.5-mile and 0.25-mile). The majority of the variable types and data elements were continuous in nature. The one exception was the “urban-rural indicator,” which was a binary variable.

The random parameter models were developed for the following outcomes: total crashes, property damage only, possible injury, evident injury, severe injury, and fatal injury. These outcomes were modeled for three scales, at the 1-mile, 0.5-mile, and 0.25-mile fixed-length segmentations.

Table 2.1 Variable types and data elements assembled for fixed-length segmentation models

Variable Type	Data Elements			
ADT	Weighted Average of ADT	Weighted Average of ADT/10000	Natural Logarithm of Weighted Average	
Horizontal curve information	Count of horizontal curves	Count of horizontal curves for specific radius range, central angle or design speed range	Proportion of horizontal curves for specific radius range, central angle or design speed range	Natural logarithm of proportion of horizontal curves for specific radius range, central angle or design speed range
Vertical curve information	Count of vertical curves	Count of vertical curves for specific K-value range or design speed range	Proportion of vertical curves for specific K-value range or design speed range, or ranges of absolute begin and ending grades	Natural logarithm of proportion of vertical curves for specific K-value range or design speed range, or ranges of absolute begin and ending grades
Travel lane information	Proportion of number of lanes in cross section			
Roadway information	Weighted average of width	Proportion of ranges of weighted average of width		
Travel shoulder information	Weighted average of width	Proportion of ranges of weighted average of width	Proportion of shoulder surface type	
Median information	Proportion of ranges of weighted average of width	Proportion of median surface type		

Table 2.2. Continuous data elements for the seven variable types

Variable Category	Continuous				
	Original Value	Natural Logarithm of Original Value	Count	Proportion	Natural Logarithm of Proportion
ADT	✓	✓			
Horizontal curve information			✓	✓	✓
Vertical curve information			✓	✓	✓
Travel lane information				✓	
Roadway information				✓	
Travel shoulder information				✓	
Median information				✓	

Table 2.3 shows the summary of crashes by the various functional classes. As shown in the table, crash summaries are broken down by years 2014 and 2015. The distribution of severity across the two years remains stable, with property-damage-only crashes resulting in around 65% to 70% of all crashes. The severity distribution across functional classes varies. Interstate crashes are comprised of 70% PDOs. On the other end of the severity spectrum, fatal crashes comprise 1.2% of all two-lane crashes, while interstate crashes consist of 0.3% fatal crashes.

Descriptive statistics for key variables used in the estimation of random parameters models are provided in Appendix B in Tables B.1 through B.3.

Table 2.3 Descriptive statistic of crash counts

Function Class	Year	Severity of Crash				
		Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Two-lane rural	2014	4,195	1,230	784	185	85
	2015	4,473	1,267	829	175	86
Two-lane urban	2014	2,544	959	294	61	16
	2015	2,831	1,009	337	67	17
Non-interstate and non-two-lane rural	2014	864	235	111	30	10
	2015	889	256	130	26	15
Non-interstate and non-two-lane urban	2014	10,326	3,663	889	164	44
	2015	11,285	4,018	1,008	195	47
Interstate	2014	9,839	2,992	728	110	34
	2015	10,973	3,193	776	118	50

3. Random parameter modeling results

The random parameters models for the various severity outcomes across the functional classes resulted in the identification of random parameters as shown in the tables that follow. For example, Tables 3.1 through 3.6 show the random parameter occurrence by variable type for functional classes named two-lane rural (TLR), two-lane urban (TLU), non-interstate, non-two-lane rural (NINTR), non-interstate, non-two-lane-urban (NINTU), and Interstate (INT). The interstate model appears to have the greatest number of random parameters, while the NINTR consists of the least number of random parameters. This pattern appears to be consistent across the severity outcomes. In the NINTR case, the higher severity models do not consist of random parameters (in particular, serious and fatal injury models). Travel shoulder variable types have the greatest number of random parameters, followed by vertical curvature variable types and travel lane and roadway variable types. This suggests that unobserved heterogeneity may be most prevalent in travel shoulder data elements, followed by vertical curvature data elements. This pattern appears to repeat across segmentation scales, namely the 0.5-mile and 0.25-mile scales. The tables for 0.5-mile and 0.25-mile segmentations are shown in Appendix C, in tables C.1 through C.12. Further in Appendix C, model estimation results are shown for all segmentations, for six severity outcomes. These tables are numbered C.13 through C.30.

Table 3.1 Random parameter occurrence of total crash models for 1-mile segments

Function Class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	1	0	0
Dummy variable	0	0	0	0	1
Horizontal curve information	2	0	0	1	1
Vertical curve information	3	0	0	2	4
Travel lane information	2	1	1	1	1
Roadway information	0	2	0	2	2
Travel shoulder information	3	3	1	0	5
Median information	0	0	0	1	1

Table 3.2 Random parameter occurrence of property-damage-only crash models for 1-mile segments

Function Class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	3	0	0	1	1
Vertical curve information	3	0	1	2	4
Travel lane information	0	1	0	1	1
Roadway information	0	2	0	0	2
Travel shoulder information	3	1	1	2	5
Median information	0	0	0	0	1

Table 3.3 Random parameter occurrence of possible injury crash models for 1-mile segments

Function Class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	2	0	0	0	3
Vertical curve information	3	1	1	2	1
Travel lane information	0	1	0	0	1
Roadway information	1	2	1	2	3
Travel shoulder information	1	0	1	2	3
Median information	0	0	0	2	1

Table 3.4 Random parameter occurrence of evident injury crash models for 1-mile segments

Function Class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	0	0	0	0	0
Vertical curve information	1	0	0	0	1
Travel lane information	1	0	1	0	0
Roadway information	0	1	1	2	1
Travel shoulder information	0	1	0	0	3
Median information	0	0	0	0	1

Table 3.5 Random parameter occurrence of serious injury crash models for 1-mile segments

Function Class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	0
Horizontal curve information	0	0	0	0	1
Vertical curve information	2	0	0	0	0
Travel lane information	0	0	0	0	0
Roadway information	0	0	0	2	2
Travel shoulder information	0	0	0	0	0
Median information	0	0	0	0	0

Table 3.6 Random parameter occurrence of fatal crash models for 1-mile segments

Function Class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	0
Horizontal curve information	0	0	0	0	1
Vertical curve information	1	1	0	0	0
Travel lane information	0	0	0	0	0
Roadway information	0	0	0	0	0
Travel shoulder information	0	0	0	0	0
Median information	0	0	0	0	0

4. Implementation framework for random parameter models

The design of the implementation framework for the random parameter models started with the definition of a set of goals and the identification of potential challenges for the framework. With these goals and challenges in mind, different implementation approaches were evaluated. Ultimately, a design for a web-based application was selected. This model was chosen for its flexibility in the presentation of the model results; scalability in incorporating both a large number of models in its initial version and the ability to accommodate yearly models in the future; and its ability to leverage existing data presentation tools.

4.1 Goals and Challenges

The primary goal of the framework was to create a system that would allow for new ways of presenting the analysis from the random parameter models. The framework should allow for the presentation of estimated and actual crash frequencies and severities. It should allow for the exploration of problematic segments by crash type and investigate model predictions of the effect of infrastructure changes on crash severity and frequency. Moreover, the framework should expose the large amount of information captured in the random parameter models in ways that can inform the transportation planning process. In capturing segment-specific heterogeneity in parameter estimates, these models hold a great amount of information about roadway segments; however, given the number of segments in the study, the richness of analysis in these models is not readily presented. Rather than fixed parameter values and summaries of central tendencies and dispersion for random parameters, the goal of this framework is to explore ways of presenting these values to be used by practitioners.

In addition to meeting the challenges in creating new ways to visualize the models, the creation of the framework faced a significant scalability challenge. Models were created for each of five functional classes and six injury severities. These thirty models cover 6,861 segments, with 99 fixed and random parameters. The values include nearly 70,000 random parameter values, as well as attribute values for each segment.

While the initial framework presents the 2014/2015 combined model, the design needed to be flexible enough to be able to include yearly models in addition. Ultimately, the inclusion of a decade or more worth of models would lead to the need to store millions of values and efficiently be able to retrieve and manipulate them.

4.2 Alternative Designs for Implementation

The first design that was explored was a spreadsheet-based system that presented the models using Excel. Although there was concern with the scalability of this approach, the design would have the advantage of

providing a familiar interface for practitioners. A prototype was developed that included only the two-lane, rural functional class. This is the largest functional class, in terms of the number of segments, so that it presented a good test for the scalability of this approach. The prototype that was developed supported concerns about the scalability of this approach. A number of the required operations were extremely slow, and given the limitations of the Excel programming language were difficult to optimize. The performance may have been acceptable if separate spreadsheets were developed for each functional class. However, this would limit the ability to analyze the entirety of many routes, since a number of routes in the Washington State road network span multiple functional classes.

Due to the scalability concerns with the Excel-based approach, a design for a web-application was selected. The web application design included static files, without the need to run any server side scripting. The static files include base html files, style sheets, data files, and a number of JavaScript files.

4.3 Requirements for Views for Web-Based System

The system was designed to provide three distinct views into the random parameter models. The views provide different levels of granularity for the exploration of the models.

At the highest level, the models can be explored at the route level. The user should be able to select a route, and then view both expected and actual crashes on segments on the route. The view should allow for the display of these crashes as a heat map on an aerial view of the route, and as a histogram plotting crashes for each segment by the adjusted route milepost (ARM).

At the next level of granularity, a driver view should allow for the exploration of a portion of a route using driver views provided on the Washington State Department of Transportation website. In addition to presenting actual crashes and estimated crashes from the models, this view should allow practitioners to explore segments, either by simulating driving on the segment or manually jumping through images.

The segment-level view will provide the ability to explore the models at the segment level. This view will present the attributes and parameters that are used by the models for each type of crash severity for a given segment. In addition, this view will allow users to explore the effect of attribute changes on model predictions for each segment.

4.4 File Structure

The web application consists of entirely static content. This content includes html files, style sheets, client-side JavaScript files, and JSON-encoded data files.

The application is accessed via an index.html file. This file contains all of the resources for the dashboard. The other html file is an about file, presenting a user guide for the system, and contact information in the case of problems.

The index.html file loads style sheets and client-side JavaScript files. The style sheets customize the display of the HTML elements. The client-side JavaScript provides the dynamic behavior of the dashboard and include the following files:

- /js/main.js: This file loads the various JSON-encoded data files and allows for navigation between views in the dashboard.
- /js/Plotting/route_select.js: This file contains the code used to respond to changes in selection of routes and starting and ending ARMs on a route.

- /js/Plotting/map.js: This file contains the code used to create a crash heat map on the Google map object.
- /js/Plotting/crashPlot.js: This file contains the code used to generate the histograms of crashes versus ARM in the Route View.
- /js/Plotting/driver.js: This file contains the code that provides the dynamic functionality in the Driver View
- /js/Plotting/segment.js: This file manages the dynamic display of items in the Segment View

The JSON-encoded data files capture all of the data that back the dashboard. This includes attributes for each segment, including both model attributes and latitude and longitude information, the parameter values used in the models, and historical crash counts. The data are structured to enable fast access based on routes and segments.

4.5 External Resources

The web-based application provides the ability to leverage existing libraries and resources. The external resources used by the application are freely available, with the exception of the Google Maps resources. However, the pricing for Google Maps provides a large quota of free usage, which should be more than adequate for internal use of the tool by the Washington State DOT, at no cost. The specific external resources include:

JQuery (https://jquery.com/) is a JavaScript library that simplifies a number of tasks, including providing multi-browser support. This library is free to use under the MIT license, allowing for commercial use, as long as the copyright header is left intact.

Bootstrap (https://getbootstrap.com/docs/) provides cascading style sheets that simplify support for multiple screen sizes and browsers. It is also available under the MIT license.

The dashboard uses the Material Dashboard React template provided by www.creative-tim.com. Like the previous two resources, this template is available under the MIT license.

Plotly (https://plot.ly/) is an open source tool for creating plots and maps. The plots that are used in the system are all available under the free tier.

Google Maps is available via a paid subscription from Google. The original system called for the use of Plotly's map capability. However, the performance of the map was poor, so the system ultimately uses Google Maps instead. The Google Maps API subscription provides a free tier with $200 worth of free usage every month, which Google asserts is enough for most users. For this system, the free usage includes 100,000 static maps per month, or about 3,300 per day. After exceeding the free usage limits, billing is at $0.50 USD per 1,000 additional requests, up to 100,000 per 24 hours. The system designers believe that this free allowance should be adequate for internal Washington State DOT usage. Currently the API key that provides access to the system is tied to the Penn State network. When the system is moved to be hosted on the Washington State website, a new API key will need to be set in the index.html file.

The final external resource is provided from the Washington State DOT system. The images for the Driver View are dynamically retrieved, as needed from the Washington State DOT State Route Web tool.

5. Demonstration of implementation framework

A demonstration of the implementation framework is presented in the form of a dashboard system. It can be accessed by using an up-to-date web browser, e.g. Chrome v. 54 or newer. The system is accessed via the url https://turing.cs.hbg.psu.edu/wsdot. The web page is currently password protected. Please send an email to jjb24@psu.edu to obtain the login credentials.

5.1 Route View

When the web page is first opened, the screen in figure 5.1 appears. From the initial screen, the user can select a route, change to a different view, or select the About/Help page.

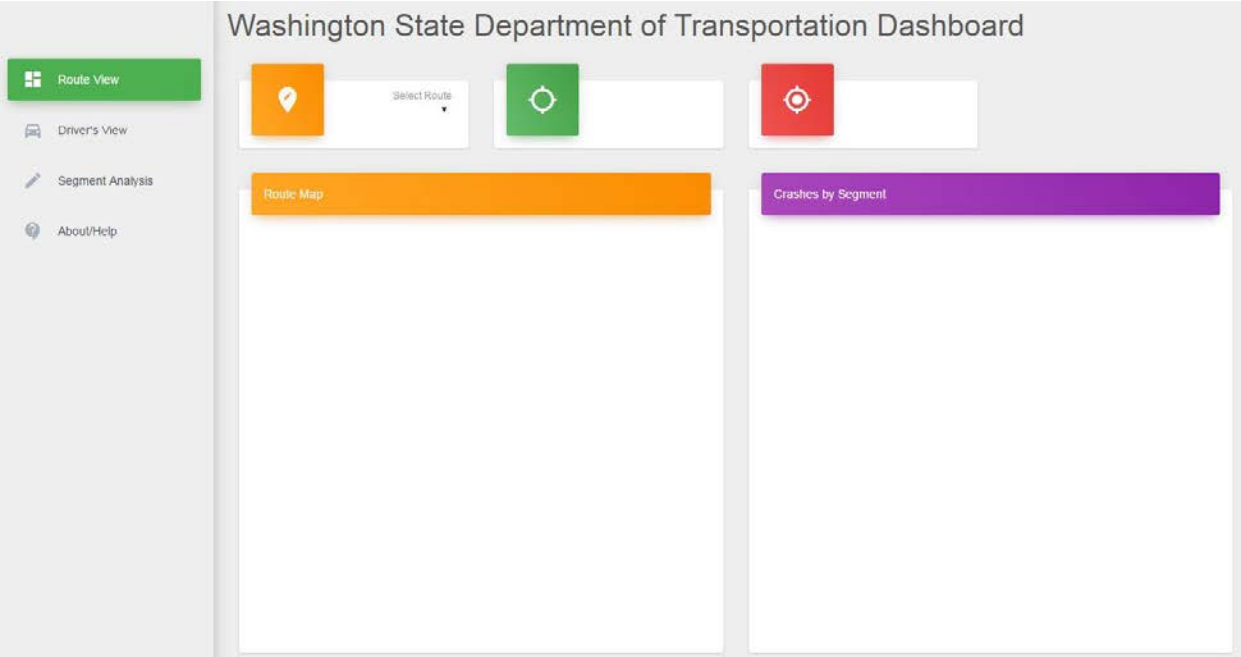

Figure 5.1: Initial dashboard screen

If the user selects a route in the initial page, a crash map and histogram are displayed on the Route View page, as shown in Figure 5.2. The map presents a heat map of crashes on the route, with the colors set dynamically for the roadway portion that is selected. Green represents segments with no crashes, while red is used for segments with the maximum number of crashes in the selected roadway portion.

Using the boxes at the top of the screen, the user can adjust the beginning and ending ARM for the route being displayed. The ARM location choices presented in the dropdowns correspond to the segments used in the random parameter models.

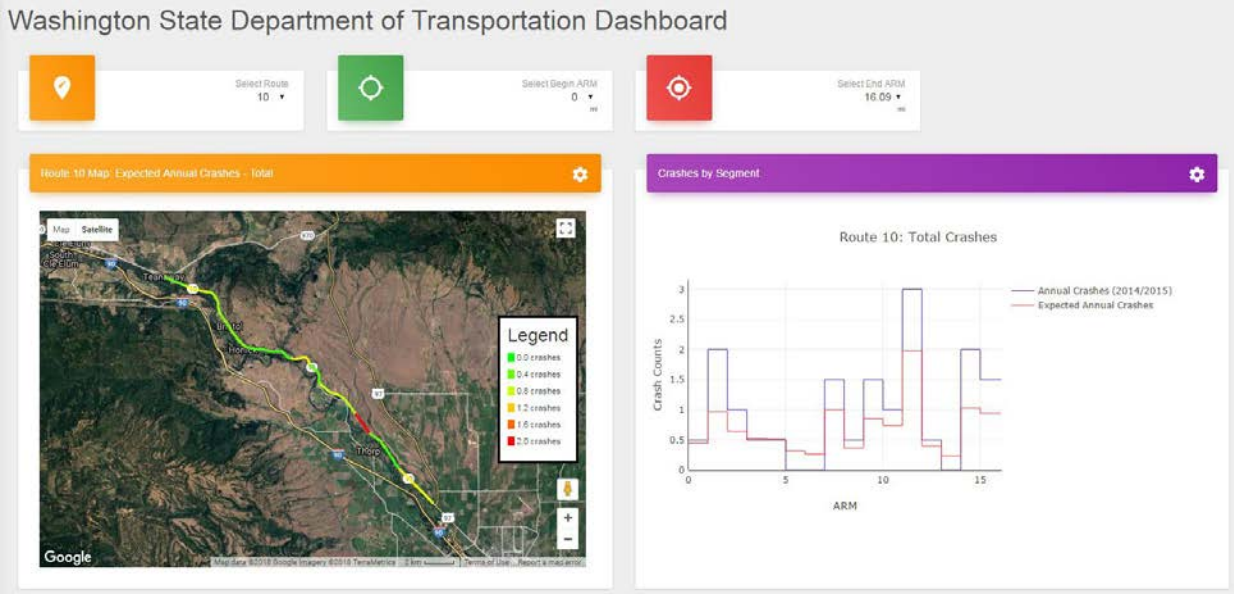

Figure 5.2: The Route View after a route has been selected

In addition to displaying a heat map, the map includes additional functionality. As shown in Figure 5.3, hovering the mouse pointer over a segment will cause an informational window to pop up with the position and crash statistics for a segment.

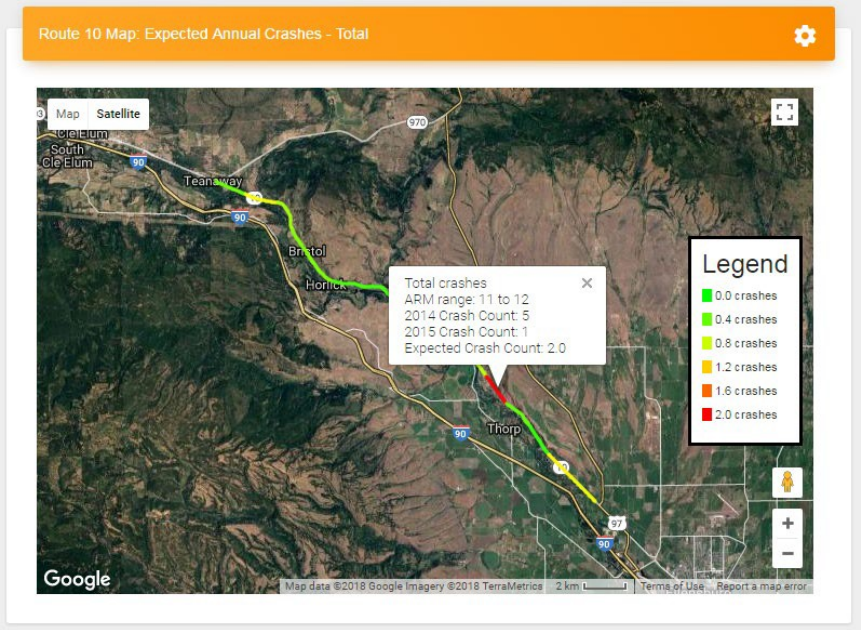

Figure 5.3: Map functionality in Route View

In addition, the map contains the typical functionality in Google Maps. Users can switch between Map and Satellite views via buttons at the top left; toggle the display of labels by hovering the mouse over these buttons; pan by clicking and dragging the map; zoom in and out using the plus and minus icons at the bottom right of the map; drag the person icon to a portion of the roadway to see a street level view; and click on the icon at the top right to see the map in full screen mode.

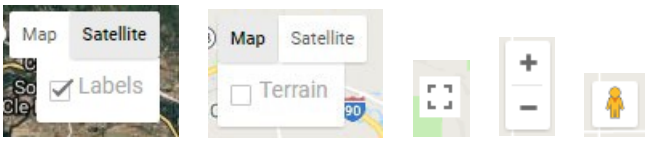

Figure 5.4: Maps API-provided functionality. From left to right, these include satellite imagery with or without map labels; a map display with or without terrain; full screen mode; zoom controls; and street-level view

The histogram also provides a set of additional functionality. As shown in Figure 5.5, hovering over the graph will show the plotted values in the graph, and the beginning ARM for a segment. Moreover, the user can click and drag to zoom in on a portion of the graph. Finally, hovering the mouse over the graph causes a set of icons to appear at the top right, which allows the user to access additional Plotly functionality.

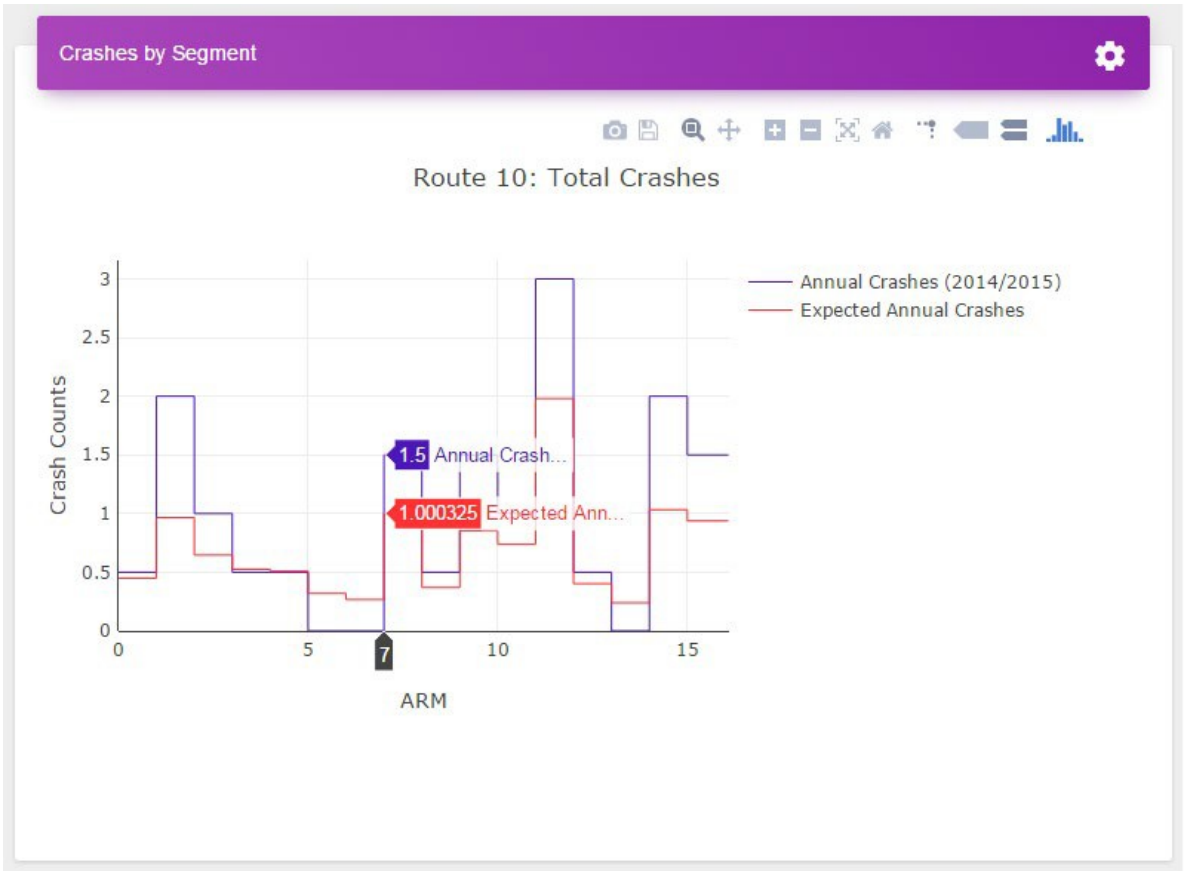

Figure 5.5: Additional functionality for the histogram

The buttons at the top of the histogram provide the following capabilities:

Download the plot as an image file. Clicking on this icon will cause an image of the graph to be downloaded in Portable Network Graphic (png) format.

This icon will open the graph in the Chart Editor on Plotly's website. The editor allows you to change the plot layout, edit the underlying data, and export the resulting chart.

When this icon will be selected, mouse interactions with the chart will cause the display to zoom.

When this icon will be selected, mouse interactions with the chart will cause the display to pan left and right, or up and down.

Clicking this icon causes the display to zoom in.

Clicking this icon causes the display to zoom out.

Clicking this icon restores the display to auto-scale, removing any effects of previous zoom and pan operations.

Clicking this icon restores the axes, which also removes any effects of previous zoom and pan operations.

The functionality provide by this icon is not used in the current system.

When this icon is selected and multiple data series are plotted, hovering over the chart will show values from the closest data series, rather than all of them.

When this icon is selected and multiple data series are plotted, hovering over the chart will show values from all of the data series, rather than just the one closest to the mouse pointer.

This icon will take the user to the Plotly website.

By default, the map in the Route View will display the predicted annual crashes from the Random Parameter Models, and the graph will display these predictions and the actual annual crashes from the years 2014 and 2015. The expected crashes are generated at the segment level based on the functional class for each segment. Thus, if a roadway contains segments from multiple functional classes (e.g., Route 2), the predictions displayed will use multiple models, choosing the model appropriate for each segment's functional class.

Clicking on the gear icons at the top of the map and the chart will display a pop-up menu that allows the user to select different values to be plotted. As shown in Figure 5.6, the menu will allow the user to select either expected or annual crashes to be displayed in the map. In addition, the user can choose to display total crashes or select crashes by injury outcome. Clicking on either the gear or the *OK* button will apply the changes to the map. For the histogram, the user can select multiple data series to be plotted at one time, in addition to being able to specify the crash type.

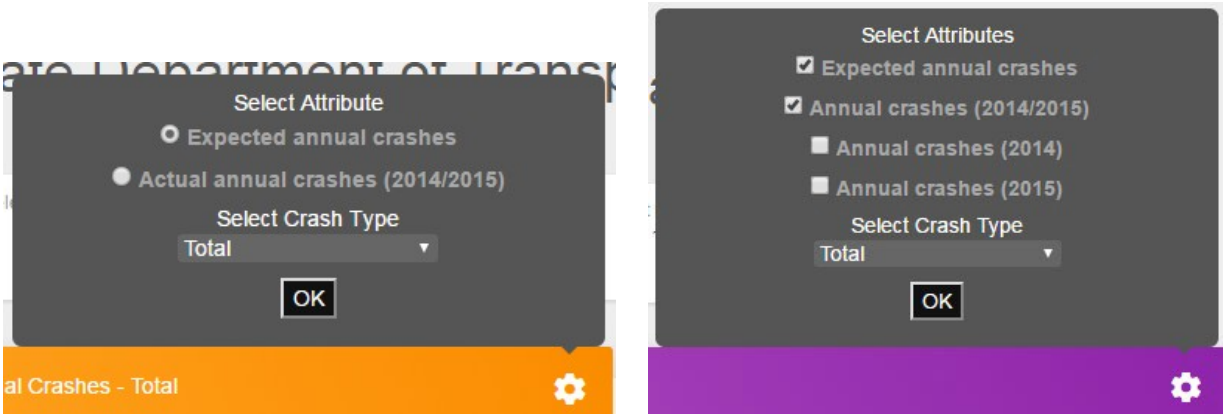

Figure 5.6: Pop-up menus for the map (left) and histogram (right) in the Route View

5.2 Driver's View

To select the Driver's View, the user should click on the corresponding icon to the left of the screen. If a route has already been selected in another view, the top of the view will appear as Figure 5.7, with an additional box at the top of the screen that controls which direction of travel is displayed, either the view from the direction of increasing mileposts or that of decreasing mileposts. If the user selects the Driver's View without first selecting a route, a route can be chosen at the top of this screen to enable this functionality.

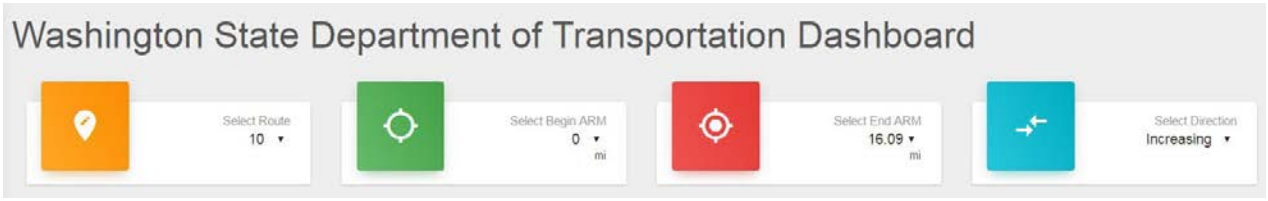

Figure 5.7: In the Driver's View, in addition to selecting a route and the beginning/ending ARMs, users may specify the direction of travel in the view

Once a route has been selected, the user can scroll through the segment, viewing the roadway from the driver's point of view, as well as expected and actual crash rates on each segment, as shown in Figure 5.8. The image on the left is the view from the front of the vehicle, and the image on the right is a view of the roadway to the right of the vehicle. The images that are displayed are dynamically served by the Washington State DOT State Route Web tool.

Figure 5.8: The Driver's View in the dashboard

The controls at the bottom of the screen provide the following functionality:

◀◀ Go back to the start of the segment. If the user is already at the start of a segment and the previous segment is a portion of the range selected at the top of the screen, this button will go to the start of the previous segment. The previous segment is defined in terms of the direction of travel. Thus if displaying views in the decreasing direction, selecting this button will increase the current ARM.

|◀ Go back 1/100th of a mile in the direction of travel, if the location is within the selected range.

▶ Play (or pause) the views as a slideshow. The playback speed slider controls how quickly images are changed in the slideshow.

▶| Go forward 1/100th of a mile in the direction of travel, if the location is within the selected range.

▶▶ Go forward to the start of the next segment in the direction of travel. If the next segment is outside of the selected range at the top of the screen, this button will go to the end of the current segment.

5.3 Segment Analysis View

The Segment Analysis View provides the ability to investigate information captured in the models at the segment level. To begin using this view, one must select a segment within the selected range for a route, which is done in the right-most box at the top of the screen (Figure 5.9).

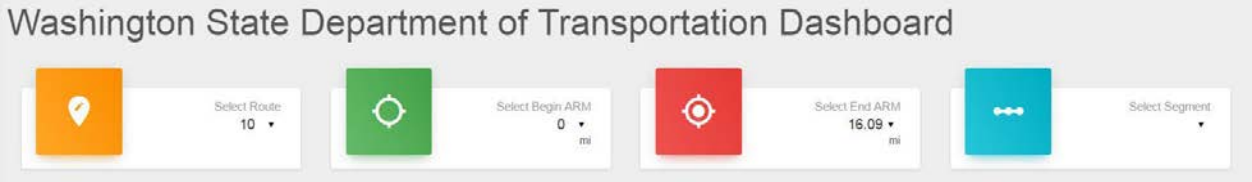

Figure 5.9: The controls for the Segment Analysis View in the dashboard

Once a segment has been selected, the four panes allow for investigation of the segment attributes and parameters. The pane at the top left provides the same map view as in the Route View, with the same functionality described previously.

The pane at the top right provides the ability to investigate the effect of changes in a segment's attribute on model predictions of the expected number of crashes. Initially this box is blank, waiting for the user to select an attribute. As shown in Figure 5.9, once an attribute is selected, the user can view the parameters associated with that attribute in models for different crash types. For example, in Figure 5.10, the user has selected attribute *Count of horizontal curves with an angle of deflection less than or equal to 500 degrees*. The system shows the current value for this attribute (2) and the parameters associated with this attribute in different models.

Alter Segment Attribute: Route 10, ARM 1 to 2

Select Attribute (grayed out attributes represent categories):
Count of horiz. curves with angle of deflection ≤ 500 deg

Current Value: 2

Select New Value: 2

Calculate expected values after change

Crash Severity	Parameter Value in Model for this Attribute	Annual Crashes (2014/2015)	Current Expected Annual Crashes	Expected Annual Crashes After Change
Total	0.077	2	0.967	
Property Damage Only	0.106	1	0.481	
Probable Injury	0.177	0.5	0.213	
Evident Injury	N/A	0.5	0.122	
Severe Injury	N/A	0	0.009	
Fatal Injury	N/A	0	0.013	

Figure 5.10: The Alter Segment box in the Segment Analysis View after an attribute has been selected

This parameter appears in the Total crash model, Property Damage Only model and the Probable Injury model. The positive values displayed for the parameters indicate that increases in this attribute value would be expected to increase the likelihood of the corresponding crash types. The "N/A" values for the parameter values in the other models indicate that this attribute was not included in those models. The table also displays the average annual crash rate for 2014 and 2015 and the expected annual crashes given the current parameter model.

Select Attribute (grayed out attributes represent categories):
Count of horiz. curves with angle of deflection ≤ 500 deg ▾

Current Value: 2

Select New Value: 1

Calculate expected values after change

Crash Severity	Parameter Value in Model for this Attribute	Annual Crashes (2014/2015)	Current Expected Annual Crashes	Expected Annual Crashes After Change
Total	0.077	2	0.967	0.895 (-7.42%)
Property Damage Only	0.106	1	0.481	0.433 (-10.02%)
Probable Injury	0.177	0.5	0.213	0.178 (-16.18%)
Evident Injury	N/A	0.5	0.122	
Severe Injury	N/A	0	0.009	
Fatal Injury	N/A	0	0.013	

Figure 5.11: The Alter Segment box in the Segment Analysis View showing the effect of a new attribute value on the predicted annual crash rate

Changing the value in the Select New Value textbox (Figure 5.11), followed by a click on the button, allows the user to investigate changes in an attribute value on the model outputs. For example, in Figure 5.12, the number of horizontal curves with a deflection of 500 degrees or less was reduced to 1. This reduction caused the models to predict 7.42% fewer total crashes, 10.02% fewer property-damage-only crashes, and 16.18% fewer probable injury crashes.

The box at the bottom right of the Segment Analysis View provides measures of central tendency and dispersion for attributes used in models for the current functional class. The attributes are grouped based on their types (e.g., attributes-related horizontal curves, roadway, median, and so on). The measures are calculated across all segments in the current functional class. Since the segment from ARM 1 to 2 in Route 10 is a two-lane, rural road, the display, shown in Figure 5.12, has statistics for this functional class. For the first attribute, as an example, the value of 2 for this segment would put this segment in the top quartile for this attribute.

Attribute Statistics: Two-Lane Rural

Attribute	Minimum	1st Quartile	Median	Mean	3rd Quartile	Maximum	Standard Deviation
Horizontal Curve							
Count of horiz. curves with angle of deflection ≤ 500 deg	0.00	0.00	0.00	0.19	0.00	5.00	0.52
Count of horiz. curves	0.00	1.00	2.00	2.54	4.00	20.00	2.50
Log proportion of horiz. curves with design speed ≤ 25 mph	-4.61	-1.51	-0.80	-0.92	0.00	0.00	0.94
Log proportion of horiz. curves with 30 ≤ design speed ≤ 35 mph	-4.61	0.00	0.00	-0.41	0.00	0.00	0.89
Log proportion of horiz. curves with 40 ≤ design speed ≤ 45	-4.61	0.00	0.00	-0.17	0.00	0.00	0.58

Figure 5.12: Summary statistics for the functional class of the chosen segment in the Segment Analysis View

The box at the bottom right of the Segment Analysis View, presents model parameters for all attributes in models for the current segment's functional class. Figure 5.13, for example, shows details on the parameters associated with the horizontal curve attribute. The Total and Probable Injury models included a fixed parameter for this attribute.

Model Parameters: Two-Lane Rural

		Fixed Parameter	Random Parameter		
Parameter	Crash Severity	Value	Value	Mean Across Segments	Standard Deviation Across Segments
Constant	Total	0.586			
	Property Damage Only		0.630	0.198	0.434
	Probable Injury		0.943	0.562	0.446
	Evident Injury		-2.205	-2.498	0.213
	Severe Injury		-2.892	-2.883	0.097
	Fatal Injury	-3.746			
Horizontal Curve					
Count of horiz. curves with angle of deflection ≤ 500 deg	Total	0.077			
	Property Damage Only		0.106	0.073	0.010
	Probable Injury	0.177			

Figure 5.13: Parameter values for the functional class of the chosen segment in the Segment Analysis View

The property-damage-only model, on the other hand, included a random parameter for this attribute. The mean values for this parameter across all segments was 0.073, with a standard deviation of 0.010. However, for this segment, the model led to a significantly higher parameter estimate of 0.106 for this parameter in the current segment. This is an example of the ability to investigate this segment-specific heterogeneity in the random parameter models, one of the key goals of this system.

6. Conclusions and recommendations

This study had two major components – the first, involving the development and testing of random parameter models at 1-mile, 0.5-mile and 0.25-mile scales to test the implementability of predictive models. The second component involves the development of a web-based implementation framework for the predictive models. The fixed-length approach at multiple scales showed that fully specified random

parameter models are estimable at multiple scales, and that the models showed significant consistencies in the identification of random parameters across functional classes. Table 6.1 presents a summary of total crash models for the 1-mile scale, 0.5-mile scale, and 0.25-mile scale.

Table 6.1 Summary of fixed-length random parameter models for total crash frequency

1-mile Scale Model Summary					
	TWLR	**TWLU**	**NINTR**	**NINTU**	**INT**
Number of Observations (2014-2015)	9612	724	646	1214	3052
Number of Parameters	41	20	17	26	45
Number of Significant Random Parameters Excluding Constant (Significant Standard Deviations)	10	6	3	7	15
Restricted Negative Binomial Log-Likelihood (Fixed Parameters at Convergence)	-14377.22	-2352.39	-1497.42	-4883.06	-4777.90
Log-Likelihood	-13824.79	-2158.54	-1434.59	-4406.63	-4486.97
AIC	27731.58	4357.08	2903.18	8865.26	9063.94
BIC	28025.58	4448.78	2979.18	8997.90	9335.00
LL Ratio	1104.86	387.70	125.66	952.86	581.85
Adjusted Pseudo R-squared	0.112	0.117	0.085	0.134	0.234
0.5-mile Scale Model Summary					
Number of Observations (2014-2015)	19316	1368	1202	2508	3054
Number of Parameters	41	20	17	26	45
Number of Significant Random Parameters Excluding Constant (Significant Standard Deviations)	10	6	1	6	13
Restricted Negative Binomial Log-Likelihood (Fixed Parameters at Convergence)	-20446.40	-3408.96	-2213.93	-8711.55	-7663.34
Log-Likelihood	-19806.08	-3172.77	-2120.57	-7889.09	-7352.23
AIC	39694.17	6385.55	4275.14	15830.18	14794.46
BIC	40016.78	6489.97	4361.70	15981.69	15065.55
Chi-Square	1280.63	472.38	186.71	1644.92	622.22
Adjusted Pseudo R-squared	0.095	0.084	0.094	0.131	0.235
0.25-mile Scale Model Summary					
Number of Observations (2014-2015)	38730	2844	2326	4918	6110
Number of Parameters	41	20	17	26	45
Number of Significant Random Parameters Excluding Constant (Significant Standard Deviations)	8	6	1	7	10
Restricted Negative Binomial Log-Likelihood (Fixed Parameters at Convergence)	-27653.42	-5394.15	-3140.65	-14074.55	-12360.07
Log-Likelihood	-26879.79	-5045.05	-2994.24	-12753.29	-11859.00
AIC	53841.58	10130.09	6022.48	25558.58	23807.99
BIC	54192.72	10249.15	6120.27	25727.60	24110.29
LL Ratio	1547.26	698.20	292.81	2642.52	1002.15
Adjusted Pseudo R-squared	0.086	0.082	0.089	0.131	0.226

As Table 6.1 shows, when the same specifications were tested across multiple scales, the pattern of heterogeneity is maintained across functional classes. Random parameters were not consistently significant across scales, due to changes in heterogeneity scale. However, across scales, the interstate models contained the greatest number of random parameters, while the two-lane rural models (TWLR) contained the second highest number of random parameters. The least number of random parameters was found to be in the non-interstate, non-two-lane urban models. The consistency of this patterns is found across severity outcomes as well. The model summaries for all severity outcomes are presented in Appendix C. Establishing random parameter consistency across scale is crucial for testing an implementation framework for predictive purposes. Consistency will ensure that any implementation framework will yield consistent predictive results at multiple scales.

We tested model consistencies across 1-mile, 0.5-mile, and 0.25-mile scales. These are discrete scales and do not represent a continuum for model testing. Therefore, two issues are worth considering in further testing for implementation frameworks. The first relates to spot improvement level scales, where the scales can be smaller than 0.25 miles in length. The second issue relates to temporal consistencies. The models tested in this study are based on a two-year period 2014-2015. Model testing across longer time periods will potentially involve time-variant heterogeneities, due to changes in the economy, enforcement effects, and vehicle model effects.

6.1 Functionality of web-based implementation framework

A dashboard was created to present the results of the random parameter models. The dashboard presents both actual crash and expected crash rates, at the segment level, for different crash types. Moreover, by presenting different views along with the roadway crash rates, including maps, histograms, and driver-level views, the dashboard can allow for investigation of areas with high crash rates. Finally, a Segment Analysis View enables the investigation of changes in parameter values, particularly for these segments. By showing random parameter values for a segment, this view provides a way to investigate the segment-specific heterogeneity captured in the random parameter models.

The following recommendations are made with respect to the implementation framework for the random parameter models:

- The demonstration system provides the opportunity to engage with Washington State practitioners on ways to explore ways that this type of system can be enhanced to maximize its utility. We recommend soliciting input on the system as it currently stands, and ways it could be enhanced, with a goal of allowing practitioners to leverage the rich information in safety models when planning infrastructure improvements.

- The current random parameter models, and limits on available data, limit the number of attributes that are included in each model. Other modelling approaches, for example ensemble models, would allow the incorporation of a larger set of attributes. The resulting models hold the potential of enabling more robust investigations of attribute changes on expected crash rates.

- The current implementation system includes models based on 2014/2015 combined crash data. The system, however, has been designed for scalability needed to be able to incorporate yearly models. The inclusion of these models, in the future, would enable investigation into changes in model parameters and crash rates over time.

- Real-time monitoring of crashes could be incorporated into the system. This capability would enable the system to present notifications to practitioners whenever current crash rates exceed predicted values by some threshold. These alerts of unusually high crash rates would then allow practitioners to identify potential problems to allow them to be addressed in a timely fashion.

Appendix A

Table A.1 Summary descriptive statistics of 0.5 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
2	2	462	15	112	57
3	3	76	5	0	39
4	4	110	0	1	13
5	5	0	0	0	0
6	6	103	0	0	0
7	7	79	10	0	27
8	8	0	0	41	0
9	9	105	58	1	19
10	10	32	0	0	0
11	11	37	5	0	0
12	12	525	0	82	42
14	14	322	7	0	31
16	16	0	0	7	47
17	17	244	4	9	13
18	18	13	0	9	35
19	19	25	0	0	0
20	20	727	29	7	27
21	21	358	0	0	0
22	22	65	6	1	0
23	23	132	0	0	0
24	24	144	10	0	3
25	25	242	0	0	0
26	26	264	3	0	0
27	27	162	5	0	13
28	28	222	32	3	13
31	31	53	0	0	0
41	41	1	0	0	0
82	82	0	0	0	0
90	90	0	0	0	0
92	92	0	15	0	1
96	96	0	6	0	7
97	97	458	1	30	11
99	99	0	0	0	98
100	100	9	0	0	0
101	101	628	14	63	26
103	103	33	0	0	0
104	104	48	3	1	11
105	105	89	6	0	2
106	106	40	0	0	0
107	107	16	0	0	0
108	108	24	0	0	0
109	109	73	6	0	1
110	110	7	0	0	0

Table A.1 (Continued) Summary descriptive statistics of 0.5 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
112	123	0	0	0	0
113	19	0	0	0	0
115	4	0	0	0	0
116	12	0	0	0	0
117	0	2	0	1	0
119	19	0	0	0	0
121	13	2	0	0	0
122	15	0	0	0	0
123	32	0	1	0	0
124	85	4	0	0	0
125	32	4	4	7	0
127	54	0	0	0	0
128	0	1	0	0	0
129	72	12	0	1	0
131	4	0	0	0	0
141	52	0	0	0	0
142	70	0	0	0	0
150	20	0	1	0	0
153	62	0	0	0	0
155	157	0	0	0	0
160	9	6	0	0	0
161	32	3	0	29	0
162	0	35	0	0	0
163	0	1	0	6	0
164	14	10	0	5	0
165	32	8	0	0	0
166	0	8	0	2	0
167	0	0	0	57	0
169	17	17	1	15	0
170	7	0	0	0	0
171	0	1	0	6	0
172	70	0	0	0	0
173	23	0	0	0	0
174	81	0	0	0	0
181	0	0	0	12	0
182	0	0	0	0	30
193	4	0	0	0	0
194	28	0	0	0	0
195	147	0	31	9	0
197	5	0	0	0	0
202	33	17	1	10	0
203	42	4	1	1	0
204	0	3	0	2	0

Table A.1 (Continued) Summary descriptive statistics of 0.5 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
205	0	0	0	0	21
206	27	3	0	1	0
207	9	0	0	0	0
211	30	0	0	0	0
213	1	0	0	0	0
215	12	0	0	0	0
221	52	0	0	0	0
223	7	0	0	0	0
224	11	4	0	5	0
225	23	0	0	0	0
231	144	0	0	0	0
240	44	13	0	23	0
241	46	4	0	0	0
243	56	0	0	0	0
260	76	0	0	0	0
261	112	0	0	0	0
262	40	0	0	0	0
263	18	0	0	0	0
270	2	2	8	8	0
271	17	0	0	0	0
272	37	0	0	0	0
274	4	0	0	0	0
278	6	0	0	0	0
281	19	0	1	0	0
282	9	1	0	0	0
283	29	0	0	0	0
285	0	0	0	10	0
290	1	9	0	25	0
291	31	5	0	11	0
292	12	0	0	0	0
300	7	0	0	0	0
302	19	12	0	2	0
303	0	0	0	18	0
304	0	0	0	6	0
305	6	19	0	2	0
307	9	1	0	0	0
308	0	6	0	1	0
310	0	0	0	4	0
395	184	0	154	34	0
397	1	33	0	10	0
401	24	0	0	0	0
405	0	0	0	0	60
409	8	0	0	0	0

Table A.1 (Continued) Summary descriptive statistics of 0.5 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
410	179	17	0	18	0
411	15	11	0	1	0
432	6	3	0	11	0
433	0	2	0	0	0
500	0	21	0	23	0
501	10	13	1	4	0
502	5	1	1	5	0
503	88	3	1	14	0
504	103	0	0	0	0
505	39	0	0	0	0
506	23	0	0	0	0
507	78	4	0	5	0
508	63	2	0	0	0
509	0	29	0	29	0
510	13	7	2	4	0
512	0	0	0	24	0
513	0	0	0	7	0
515	0	0	0	15	0
516	0	10	0	23	0
518	0	0	0	7	0
519	0	0	0	2	0
520	0	0	0	25	0
522	0	5	0	44	0
523	0	0	0	3	0
524	0	15	0	14	0
525	40	3	3	15	0
526	0	0	0	9	0
527	0	0	0	18	0
528	0	0	0	6	0
529	0	0	0	15	0
530	97	4	0	0	0
531	11	6	0	3	0
532	18	0	2	0	0
534	10	0	0	0	0
536	3	6	1	0	0
538	0	2	0	5	0
539	5	3	15	7	0
542	105	3	2	4	0
543	0	0	2	0	0
544	18	0	0	0	0
546	16	0	0	0	0
547	19	0	0	0	0
548	17	11	0	0	0

Table A.1 (Continued) Summary descriptive statistics of 0.5 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
599	0	0	0	3	0
702	18	0	0	0	0
704	0	0	0	1	0
705	0	0	0	0	3
706	27	0	0	0	0
730	12	0	0	0	0
821	49	1	0	0	0
823	0	3	0	7	0
900	4	7	0	19	0
902	25	0	0	0	0
903	20	0	0	0	0
904	27	2	0	5	0
906	4	0	1	0	0
970	20	0	0	0	0
971	21	0	0	0	0
Total	9,658	684	601	1,254	1,527
Total length (mile)	4,829.9	342.98	299.92	629.3	763.83

Table A.2 Summary descriptive statistics of 0.25 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
2	933	31	213	114	0
3	152	11	0	76	0
4	221	0	1	27	0
5	0	0	0	0	1106
6	205	0	0	0	0
7	157	21	0	55	0
8	0	0	83	0	0
9	211	117	1	37	0
10	64	0	0	0	0
11	72	12	1	0	0
12	1055	1	158	84	0
14	645	16	0	60	0
16	0	0	15	93	0
17	488	8	18	26	0
18	26	0	17	70	0
19	50	0	0	0	0
20	1457	60	14	50	0
21	717	0	0	0	0
22	130	11	2	0	0
23	264	0	0	0	0
24	290	20	0	5	0
25	485	0	0	0	0
26	528	6	0	0	0
27	324	12	0	23	0
28	448	65	6	22	0
31	107	0	0	0	0
41	1	0	0	0	0
82	0	0	0	0	530
90	0	0	0	0	1190
92	0	31	0	1	0
96	0	13	0	14	0
97	920	3	57	22	0
99	0	0	0	196	0
100	18	0	0	0	0
101	1258	31	125	48	0
103	66	0	0	0	0
104	95	7	3	21	0
105	178	11	0	5	0
106	80	0	0	0	0
107	31	0	0	0	0
108	48	0	0	0	0
109	147	13	0	1	0
110	13	0	0	0	0

Table A.2 (Continued) Summary descriptive statistics of 0.25 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
112	245	0	0	0	0
113	38	0	0	0	0
115	9	0	0	0	0
116	24	0	0	0	0
117	0	4	0	1	0
119	37	0	0	0	0
121	25	5	0	0	0
122	31	0	0	0	0
123	64	0	1	0	0
124	171	7	0	0	0
125	65	8	8	14	0
127	107	0	0	0	0
128	0	2	0	0	0
129	143	25	0	2	0
131	8	0	0	0	0
141	104	0	0	0	0
142	141	0	0	0	0
150	43	0	1	0	0
153	123	0	0	0	0
155	313	0	0	0	0
160	19	11	0	0	0
161	63	9	0	57	0
162	0	69	0	0	0
163	0	2	0	11	0
164	28	21	0	9	0
165	64	17	0	0	0
166	0	16	0	4	0
167	0	0	0	114	0
169	36	34	0	31	0
170	14	0	0	0	0
171	0	3	0	12	0
172	140	0	0	0	0
173	46	0	0	0	0
174	162	0	0	0	0
181	0	0	0	24	0
182	0	0	0	0	60
193	8	0	0	0	0
194	56	0	0	0	0
195	296	0	59	18	0
197	10	0	0	0	0
202	67	34	2	19	0
203	86	9	1	1	0
204	0	7	0	2	0

Table A.2 (Continued) Summary descriptive statistics of 0.25 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
205	0	0	0	0	42
206	53	7	0	1	0
207	17	0	0	0	0
211	61	0	0	0	0
213	1	0	0	0	0
215	25	0	0	0	0
221	104	0	0	0	0
223	15	0	0	0	0
224	21	9	0	10	0
225	45	0	0	0	0
231	288	0	0	0	0
240	88	27	0	45	0
241	93	7	0	0	0
243	113	0	0	0	0
260	152	0	0	0	0
261	224	0	0	0	0
262	80	0	0	0	0
263	36	0	0	0	0
270	3	5	16	15	0
271	33	0	0	0	0
272	76	0	0	0	0
274	8	0	0	0	0
278	11	0	0	0	0
281	40	0	0	1	0
282	18	2	0	0	0
283	58	0	0	0	0
285	0	0	0	20	0
290	3	17	0	51	0
291	62	10	0	21	0
292	24	0	0	0	0
300	13	0	0	0	0
302	38	25	0	4	0
303	0	0	0	37	0
304	0	0	0	12	0
305	11	40	0	2	0
307	20	1	0	0	0
308	0	13	0	1	0
310	0	0	0	7	0
395	370	0	307	69	0
397	1	68	0	20	0
401	48	0	0	0	0
405	0	0	0	0	121
409	15	0	0	0	0

Table A.2 (Continued) Summary descriptive statistics of 0.25 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
410	358	35	0	35	0
411	29	23	0	1	0
432	12	6	0	23	0
433	0	3	0	0	0
500	0	45	0	44	0
501	21	25	1	8	0
502	11	2	1	10	0
503	178	5	1	28	0
504	207	0	0	0	0
505	77	0	0	0	0
506	46	0	0	0	0
507	156	10	0	8	0
508	128	3	0	0	0
509	0	58	0	60	0
510	27	15	3	7	0
512	0	0	0	48	0
513	0	0	0	13	0
515	0	0	0	31	0
516	0	20	0	46	0
518	0	0	0	14	0
519	0	0	0	3	0
520	0	0	0	51	0
522	0	12	0	85	0
523	0	0	0	6	0
524	0	34	0	24	0
525	81	8	6	27	0
526	0	0	0	18	0
527	0	0	0	37	0
528	0	0	0	13	0
529	0	0	0	31	0
530	194	7	0	0	0
531	22	12	0	5	0
532	36	0	4	0	0
534	20	0	0	0	0
536	6	13	1	1	0
538	0	4	0	10	0
539	11	5	29	15	0
542	213	6	3	7	0
543	0	0	4	0	0
544	36	0	0	0	0
546	31	0	0	0	0
547	38	0	0	0	0
548	32	23	0	0	0

Table A.2 (Continued) Summary descriptive statistics of 0.25 mile fixed-length segments for all functional classes

Route	Functional Class				
	Two-lane Rural	Two-lane Urban	Non-two-lane and Non-Interstate Rural	Non-two-lane and Non-Interstate Urban	Interstate
599	0	0	0	7	0
702	37	0	0	0	0
704	0	0	0	2	0
705	0	0	0	0	6
706	55	0	0	0	0
730	24	0	0	0	0
821	98	2	0	0	0
823	0	10	0	11	0
900	8	15	0	38	0
902	49	0	0	0	0
903	40	0	0	0	0
904	54	7	0	7	0
906	10	0	1	0	0
970	41	0	0	0	0
971	41	0	0	0	0
Total	19,365	1,422	1,163	2,459	3,055
Total length (mile)	4839.78	356.58	290.04	615.7	763.83

Appendix B

Table B.1 Descriptive statistics of significant variables for 1 mile fixed-length segment models

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
AADT	AADT (ADTK10=AADT/10000)			1.012 (1.601)	view	4.677 (5.212)
LNADT	Natural log of AADT			8.256 (1.593)		
URBAN	Location indicator (if segment is located in urban area, 1, otherwise, 0)					0.389 (0.488)
Horizontal curve information						
NHC	Count of horizontal curves within the fixed-length segment	2.539 (2.496)	2.058 (2.093)			1.435 (1.118)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.189 (0.519)			0.287 (0.660)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.048 (0.269)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.223 (0.684)	0.196 (0.539)			
NHCR710	Count of horizontal curves with 700 <= radius < 1000 (feet) within the fixed-length segment	0.390 (0.838)				
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	0.279 (0.659)				
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	0.138 (0.504)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.113 (0.438)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					0.216 (0.524)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment					0.053 (0.121)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.029 (0.321)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	-0.453 (0.922)		-0.726 (1.001)		
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.920 (0.936)	-1.002 (1.058)		-0.781 (1.041)	
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.408 (0.894)		-0.324 (0.783)	-0.345 (0.841)	
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.167 (0.580)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.167 (0.604)	-0.178 (0.662)			

Table B.1 (Continued) Descriptive statistics of significant variables for 1 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Vertical curve information						
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.762 (1.079)			0.880 (1.068)	
NVBSL68	Count of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.118 (0.450)				
NVC	Count of vertical curves within the fixed-length segment	3.341 (2.606)	3.532 (3.035)			
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	1.013 (1.350)	1.105 (1.417)		1.060 (1.427)	0.317 (0.762)
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.544 (0.828)			0.661 (0.907)	0.392 (0.717)
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.167 (0.712)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.292 (0.566)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment	0.777 (1.106)	0.721 (1.170)			
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	0.370 (0.645)				
LVASL02	Natural log of proportion of vertical curves with absolute ahead slope < 2 within the fixed-length segment	-1.905 (1.267)		-1.837 (1.059)		
LVASL24	Natural log of proportion of vertical curves with 2 <= absolute ahead slope < 4 within the fixed-length segment				-1.512 (1.583)	
LVASL46	Natural log of proportion of vertical curves with 4 <= absolute ahead slope < 6 within the fixed-length segment	-0.841 (1.374)			-0.735 (1.342)	
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-1.288 (1.500)		-1.030 (1.329)	-1.419 (1.468)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	-0.271 (0.910)				
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-1.076 (1.218)			-1.125 (1.224)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	-0.904 (1.252)	-0.914 (1.360)	-0.766 (1.169)	-1.004 (1.286)	
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	-0.893 (1.168)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.631 (1.145)		-0.256 (0.808)		
LVSP3035	Natural log of proportion of vertical curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.331 (0.895)	-0.486 (1.108)			

Table B.1 (Continued) Descriptive statistics of significant variables for 1 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
LVSP6065	Natural log of proportion of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	-0.684 (1.154)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	-1.470 (1.172)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment					0.119 (0.107)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment					0.049 (0.080)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment					0.001 (0.011)
Travel lane information						
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	0.998 (0.039)				
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.401 (0.476)	0.920 (0.226)	0.895 (0.280)	0.904 (0.237)	
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	0.588 (0.479)				
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction	0.009 (0.068)		0.035 (0.153)	0.065 (0.186)	0.452 (0.482)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.401 (0.476)		0.691 (0.447)		
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					0.013 (0.113)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction	0.009 (0.068)		0.242 (0.416)		
Roadway information						
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable	11.579 (1.368)	14.179 (5.084)	21.315 (5.005)	24.472 (6.302)	30.362 (8.428)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable	0.970 (0.126)		0.218 (0.381)	0.082 (0.233)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable	0.026 (0.115)		0.744 (0.392)	0.584 (0.374)	0.596 (0.476)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				0.264 (0.311)	0.284 (0.422)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.095 (0.252)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	0.972 (0.123)	0.754 (0.354)	0.182 (0.351)	0.079 (0.232)	
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable	0.025 (0.111)	0.194 (0.296)	0.769 (0.375)	0.616 (0.361)	

Table B.1 (Continued) Descriptive statistics of significant variables for 1 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Travel shoulder information						
SDWL24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left side in increasing milepost direction, as continuous variable	0.333 (0.439)				
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.532 (0.481)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.159 (0.345)
SDWLC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the left-center side in increasing milepost direction, as continuous variable	0.078 (0.260)				
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	0.213 (0.390)	0.068 (0.224)			
SDWR10P	Proportion of travel shoulder width is wider than 10 ft. on the right side in increasing milepost direction, as continuous variable				0.011 (0.072)	
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.336 (0.439)	0.219 (0.351)		0.029 (0.129)	
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.139 (0.293)		0.055 (0.187)	
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.292 (0.393)		0.164 (0.308)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.092 (0.248)		0.334 (0.430)	0.908 (0.227)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					3.846 (2.370)
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable			0.545 (0.479)	0.153 (0.332)	
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.149 (0.337)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.031 (0.158)

Table B.1 (Continued) Descriptive statistics of significant variables for 1 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Travel shoulder information						
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.065 (0.218)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	0.478 (0.486)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.016 (0.081)	0.179 (0.323)	0.047 (0.164)	0.372 (0.434)	
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.444 (0.476)			0.582 (0.432)	0.912 (0.231)
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.479 (0.486)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	0.017 (0.084)	0.166 (0.308)	0.050 (0.168)	0.364 (0.431)	
SSFRG	Proportion of shoulder surface type is gravel on the right side in increasing milepost direction, as continuous variable	0.047 (0.205)				
SSFRNA	There's no shoulder on the right side in increasing milepost direction within this segment	0.008 (0.067)				
Median information						
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable			0.156 (0.339)	0.254 (0.380)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.133 (0.322)	0.199 (0.349)	0.113 (0.294)
MWD3040	Proportion of median width is in the 30.01 to 40.0 foot range, as continuous variable				0.069 (0.226)	
MWD4050	Proportion of median width in 40.01 to 50.0 foot range, as continuous variable				0.040 (0.174)	

Table B.2 Descriptive statistics of significant variables for 0.5 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
AADT	AADT (ADTK10=AADT/10000)			1.237 (0.710)		5.736 (53020.450)
LNADT	Natural log of AADT			9.274 (0.563)		
URBAN	Location indicator (if segment is located in urban arear, 1, otherwise, 0)					0.390 (0.488)
Horizontal curve information						
NHC	Count of horizontal curves within the fixed-length segment	1.388 (1.441)	1.186 (1.333)			0.862 (0.767)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.098 (0.350)			0.165 (0.462)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.028 (0.195)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.116 (0.438)	0.129 (0.415)			
NHCR710	Count of horizontal curves with 700 <= radius < 1000 (feet) within the fixed-length segment	0.208 (0.546)				
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	0.157 (0.441)				
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	0.079 (0.331)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.066 (0.288)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					0.132 (0.389)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment					0.053 (0.150)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.013 (0.199)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	-0.220 (0.624)		-0.379 (0.712)		
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.663 (0.829)	-0.672 (0.900)		-0.473 (0.823)	
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.203 (0.603)		-0.166 (0.509)	-0.169 (0.560)	
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.089 (0.401)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.082 (0.397)	-0.090 (0.417)			

Table B.2 (Continued) Descriptive statistics of significant variables for 0.5 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Vertical curve information						
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.414 (0.714)			0.476 (0.748)	
NVBSL68	Count of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.064 (0.290)				
NVC	Count of vertical curves within the fixed-length segment	1.792 (1.544)	1.800 (1.779)			
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	0.540 (0.861)	0.532 (0.886)		0.578 (0.936)	0.169 (0.484)
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.294 (0.570)			0.364 (0.636)	0.227 (0.516)
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.086 (0.431)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.164 (0.414)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment	0.428 (0.722)	0.371 (0.741)			
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	0.200 (0.456)				
LVASL02	Natural log of proportion of vertical curves with absolute ahead slope < 2 within the fixed-length segment	-1.409 (1.266)		-1.434 (1.107)		
LVASL24	Natural log of proportion of vertical curves with 2 <= absolute ahead slope < 4 within the fixed-length segment				-0.873 (1.294)	
LVASL46	Natural log of proportion of vertical curves with 4 <= absolute ahead slope < 6 within the fixed-length segment	-0.454 (1.000)			-0.384 (0.946)	
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-0.747 (1.189)		-0.588 (1.059)	-0.815 (1.208)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	-0.137 (0.603)				
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.641 (0.970)			-0.659 (0.982)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	-0.463 (0.903)	-0.481 (1.000)	-0.409 (0.847)	-0.557 (0.992)	
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	-0.521 (0.904)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.360 (0.839)		-0.099 (0.462)		
LVSP3035	Natural log of proportion of vertical curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.175 (0.611)	-0.257 (0.743)			

Table B.2 (Continued) Descriptive statistics of significant variables for 0.5 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
LVSP6065	Natural log of proportion of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	-0.332 (0.794)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	-0.981 (1.071)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment					0.125 (0.142)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment					0.054 (0.112)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment					0.001 (0.016)
Travel lane information						
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	1.000 (0.002)				
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.402 (0.481)	0.924 (0.238)	0.918 (0.251)	0.905 (0.248)	
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	0.587 (0.484)				
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction	0.009 (0.072)		0.040 (0.171)	0.066 (0.201)	0.453 (0.487)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.402 (0.481)		0.702 (0.445)		
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					0.013 (0.113)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction	0.009 (0.072)		0.261 (0.429)		
Roadway information						
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable	11.524 (1.192)	12.497 (2.410)	22.780 (4.235)	25.087 (6.252)	30.376 (8.569)
RDEC012	Proportion of roadway width in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable	0.974 (0.125)		0.107 (0.280)	0.044 (0.160)	
RDEC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in decreasing milepost direction, as continuous variable	0.023 (0.116)		0.838 (0.327)	0.598 (0.395)	0.596 (0.479)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				0.282 (0.345)	0.284 (0.430)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.095 (0.262)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	0.974 (0.125)	0.845 (0.297)	0.087 (0.250)	0.049 (0.176)	
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable	0.023 (0.116)	0.147 (0.286)	0.845 (0.315)	0.631 (0.378)	

Table B.2 (Continued) Descriptive statistics of significant variables for 0.5 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Travel shoulder information						
SDWL24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left side in increasing milepost direction, as continuous variable	0.332 (0.451)				
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.532 (0.487)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.159 (0.352)
SDWLC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the left-center side in increasing milepost direction, as continuous variable	0.078 (0.264)				
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	0.213 (0.398)	0.072 (0.241)			
SDWR10P	Proportion of travel shoulder width is wider than 10 ft. on the right side in increasing milepost direction, as continuous variable				0.012 (0.082)	
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.336 (0.452)	0.232 (0.382)		0.026 (0.125)	
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.163 (0.334)		0.045 (0.177)	
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.321 (0.430)		0.150 (0.316)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.076 (0.240)		0.337 (0.443)	0.908 (0.244)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					3.846 (2.467)
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable			0.595 (0.476)	0.155 (0.343)	
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.149 (0.343)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.031 (0.164)

Table B.2 (Continued) Descriptive statistics of significant variables for 0.5 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Travel shoulder information						
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.065 (0.230)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	0.477 (0.491)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.016 (0.092)	0.120 (0.286)	0.044 (0.176)	0.399 (0.455)	
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.445 (0.483)			0.564 (0.451)	0.912 (0.242)
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.478 (0.491)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	0.017 (0.096)	0.112 (0.274)	0.048 (0.184)	0.388 (0.452)	
SSFRG	Proportion of shoulder surface type is gravel on the right side in increasing milepost direction, as continuous variable	0.047 (0.207)				
SSFRNA	There's no shoulder on the right side in increasing milepost direction within this segment	0.009 (0.076)				
Median surface information						
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable			0.165 (0.353)	0.253 (0.397)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.146 (0.336)	0.202 (0.368)	0.113 (0.305)
MWD3040	Proportion of median width is in the 30.01 to 40.0 foot range, as continuous variable				0.072 (0.243)	
MWD4050	Proportion of median width in 40.01 to 50.0 foot range, as continuous variable				0.039 (0.183)	

Table B.3 Descriptive statistics of significant variables for 0.25 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
AADT	AADT (ADTK10=AADT/10000)			1.247 (0.716)		5.740 (5.304)
LNADT	Natural log of AADT			9.284 (0.554)		
URBAN	Location indicator (if segment is located in urban arear, 1, otherwise, 0)					0.390 (0.488)
Horizontal curve information						
NHC	Count of horizontal curves within the fixed-length segment	0.811 (0.899)	0.684 (0.842)			0.567 (0.591)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.053 (0.247)			0.090 (0.322)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.018 (0.146)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.063 (0.287)	0.071 (0.287)			
NHCR710	Count of horizontal curves with 700 <= radius < 1000 (feet) within the fixed-length segment	0.117 (0.371)				
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	0.095 (0.320)				
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	0.050 (0.242)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.042 (0.215)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					0.088 (0.299)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment					0.053 (0.178)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.006 (0.117)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	-0.101 (0.398)		-0.208 (0.533)		
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.428 (0.682)	-0.419 (0.726)		-0.255 (0.577)	
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.096 (0.388)		-0.082 (0.349)	-0.084 (0.374)	
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.047 (0.277)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.040 (0.258)	-0.049 (0.306)			

Table B.3 (Continued) Descriptive statistics of significant variables for 0.25 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Vertical curve information						
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.237 (0.500)			0.284 (0.540)	
NVBSL68	Count of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.036 (0.201)				
NVC	Count of vertical curves within the fixed-length segment	1.019 (0.975)	1.012 (1.098)			
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	0.303 (0.584)	0.303 (0.606)		0.324 (0.625)	0.100 (0.339)
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.169 (0.414)			0.208 (0.461)	0.135 (0.373)
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.045 (0.271)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.097 (0.314)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment	0.256 (0.511)	0.215 (0.501)			
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	0.118 (0.341)				
LVASL02	Natural log of proportion of vertical curves with absolute ahead slope < 2 within the fixed-length segment	-0.909 (1.117)		-0.895 (1.014)		
LVASL24	Natural log of proportion of vertical curves with 2 <= absolute ahead slope < 4 within the fixed-length segment				-0.447 (0.919)	
LVASL46	Natural log of proportion of vertical curves with 4 <= absolute ahead slope < 6 within the fixed-length segment	-0.242 (0.709)			-0.199 (0.641)	
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-0.396 (0.849)		-0.331 (0.784)	-0.452 (0.899)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	-0.068 (0.391)				
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.347 (0.710)			-0.359 (0.729)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	-0.222 (0.605)	-0.204 (0.614)	-0.179 (0.539)	-0.261 (0.647)	
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	-0.278 (0.645)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.183 (0.565)		-0.051 (0.307)		
LVSP3035	Natural log of proportion of vertical curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.086 (0.394)	-0.134 (0.511)			

Table B.3 (Continued) Descriptive statistics of significant variables for 0.25 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
LVSP6065	Natural log of proportion of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	-0.153 (0.510)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	-0.569 (0.855)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment					0.139 (0.200)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment					0.060 (0.155)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment					0.001 (0.019)
Travel lane information						
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	1.000 (0.001)				
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.403 (0.484)	0.925 (0.245)	0.918 (0.256)	0.904 (0.262)	
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	0.586 (0.487)				
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction	0.009 (0.076)		0.041 (0.178)	0.067 (0.217)	0.452 (0.491)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.403 (0.485)		0.693 (0.453)		
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					0.013 (0.113)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction	0.009 (0.076)		0.270 (0.436)		
Roadway information						
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable	11.525 (1.302)	12.570 (2.716)	23.036 (4.079)	25.419 (6.528)	30.376 (8.681)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable	0.974 (0.135)		0.086 (0.263)	0.026 (0.129)	
RDEC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in decreasing milepost direction, as continuous variable	0.023 (0.126)		0.862 (0.316)	0.605 (0.423)	0.596 (0.482)
RDEC2436	Proportion of roadway width is in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				0.290 (0.381)	0.284 (0.436)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.095 (0.273)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	0.975 (0.135)	0.835 (0.329)	0.065 (0.228)	0.032 (0.149)	
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable	0.023 (0.126)	0.157 (0.317)	0.870 (0.304)	0.639 (0.406)	

Table B.3 (Continued) Descriptive statistics of significant variables for 0.25 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Travel shoulder information						
SDWL24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left side in increasing milepost direction, as continuous variable	0.332 (0.460)				
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.532 (0.490)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.159 (0.356)
SDWLC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the left-center side in increasing milepost direction, as continuous variable	0.078 (0.266)				
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	0.213 (0.403)	0.070 (0.244)			
SDWR10P	Proportion of travel shoulder width is wider than 10 ft. on the right side in increasing milepost direction, as continuous variable				0.012 (0.093)	
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.336 (0.460)	0.227 (0.393)		0.021 (0.126)	
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.163 (0.347)		0.042 (0.185)	
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.315 (0.440)		0.146 (0.329)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.079 (0.252)		0.344 (0.455)	0.908 (0.255)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					3.845 (2.537)
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable			0.616 (0.475)	0.159 (0.355)	
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.149 (0.348)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.031 (0.168)

Table B.3 (Continued) Descriptive statistics of significant variables for 0.25 mile fixed-length segment model

Variable	Description	TL RUR	TL URB	NINT RUR	NINT URB	INT
		Mean (standard deviation)				
Travel shoulder information						
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.065 (0.237)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	0.476 (0.494)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.016 (0.102)	0.133 (0.316)	0.036 (0.170)	0.402 (0.470)	
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.446 (0.488)			0.562 (0.467)	0.912 (0.252)
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.477 (0.494)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	0.017 (0.106)	0.124 (0.302)	0.040 (0.175)	0.392 (0.467)	
SSFRG	Proportion of shoulder surface type is gravel on the right side in increasing milepost direction, as continuous variable	0.047 (0.209)				
SSFRNA	There's no shoulder on the right side in increasing milepost direction within this segment	0.009 (0.082)				
Median surface information						
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable			0.168 (0.362)	0.258 (0.414)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.148 (0.345)	0.207 (0.385)	0.113 (0.311)
MWD3040	Proportion of median width is in the 30.01 to 40.0 foot range, as continuous variable				0.074 (0.253)	
MWD4050	Proportion of median width in 40.01 to 50.0 foot range, as continuous variable				0.041 (0.191)	

Appendix C

Table C.1 Random parameter occurrence of total crash models for 0.5 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	1	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	2	0	0	1	1
Vertical curve information	3	0	0	1	3
Travel lane information	2	1	0	1	1
Roadway information	0	2	0	2	2
Travel shoulder information	3	3	0	0	4
Median information	0	0	0	1	1

Table C.2 Random parameter occurrence of property damage only crash models for 0.5 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	3	0	0	1	0
Vertical curve information	2	0	1	2	1
Travel lane information	0	1	0	1	0
Roadway information	0	2	0	0	0
Travel shoulder information	3	1	0	2	1
Median information	0	0	0	0	0

Table C.3 Random parameter occurrence of possible injury crash models for 0.5 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	1	0	0	0	0
Vertical curve information	3	1	0	1	1
Travel lane information	0	1	0	0	1
Roadway information	1	1	1	2	3
Travel shoulder information	1	0	0	1	2
Median information	0	0	0	2	0

Table C.4 Random parameter occurrence of evident injury crash models for 0.5 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	0	0	0	0	0
Vertical curve information	1	0	0	0	1
Travel lane information	1	0	1	0	1
Roadway information	0	0	1	1	1
Travel shoulder information	0	1	0	0	2
Median information	0	0	0	0	0

Table C.5 Random parameter occurrence of serious injury crash models for 0.5 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	0
Horizontal curve information	0	0	0	0	0
Vertical curve information	1	0	0	0	0
Travel lane information	0	0	0	0	0
Roadway information	0	0	0	0	1
Travel shoulder information	0	0	0	0	0
Median information	0	0	0	0	0

Table C.6 Random parameter occurrence of fatal crash models for 0.5 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	0	0	0	0	1
Vertical curve information	1	0	0	0	0
Travel lane information	0	0	0	0	0
Roadway information	0	0	0	0	0
Travel shoulder information	0	0	0	0	0
Median information	0	0	0	0	0

Table C.7 Random parameter occurrence of total crash models for 0.25 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	1	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	0	0	0	1	0
Vertical curve information	3	0	0	2	3
Travel lane information	2	1	0	1	1
Roadway information	0	2	0	2	2
Travel shoulder information	3	3	0	0	2
Median information	0	0	0	1	1

Table C.8 Random parameter occurrence of property damage only crash models for 0.25 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	2	0	0	0	0
Vertical curve information	2	0	1	2	2
Travel lane information	0	1	0	0	1
Roadway information	0	2	0	0	2
Travel shoulder information	3	1	0	2	3
Median information	0	0	0	0	0

Table C.9 Random parameter occurrence of possible injury crash models for 0.25 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	1	0	0	0	0
Vertical curve information	2	1	0	0	1
Travel lane information	0	1	0	0	1
Roadway information	1	2	1	2	2
Travel shoulder information	1	0	1	2	1
Median information	0	0	0	2	0

Table C.10 Random parameter occurrence of evident injury crash models for 0.25 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	0	0	0	0	0
Vertical curve information	1	0	0	0	0
Travel lane information	1	0	1	0	1
Roadway information	0	0	1	2	1
Travel shoulder information	0	0	0	0	1
Median information	0	0	0	0	0

Table C.11 Random parameter occurrence of serious injury crash models for 0.25 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	0
Horizontal curve information	0	0	0	0	0
Vertical curve information	2	0	0	0	0
Travel lane information	0	0	0	0	0
Roadway information	0	0	0	1	1
Travel shoulder information	0	0	0	0	0
Median information	0	0	0	0	0

Table C.12 Random parameter occurrence of fatal crash models for 0.25 mile segments

Function class	TLR	TLU	NINTR	NINTU	INT
ADT	0	0	0	0	0
Urban-rural indicator	0	0	0	0	1
Horizontal curve information	0	0	0	0	1
Vertical curve information	1	0	0	0	0
Travel lane information	0	0	0	0	0
Roadway information	0	0	0	0	0
Travel shoulder information	0	0	0	0	0
Median information	0	0	0	0	0

Table C.13 Total crash models by functional classes for 1 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
Constant		0.586 (5.58)				
NHC	Count of horizontal curves within the fixed-length segment		-0.032 (-4.24)			
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.077 (4.14)			-0.139 (-11.52)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.187 (6.93)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.070 (4.36)	0.170 (6.29)			
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.101 (-5.00)				
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	-0.067 (-2.54)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.115 (7.88)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.100 (-5.85)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment					0.138 (8.05)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.140 (-6.41)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	0.049 (3.63)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment		-0.066 (-5.36)		-0.085 (-13.26)	
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.071 (-4.51)		-0.084 (-3.79)		
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.068 (-3.36)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.043 (-3.00)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	0.039 (3.77)			0.096 (20.39)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.056 (4.26)				
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.115 (6.65)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					-0.944 (-5.61)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			-0.072 (-4.61)		

Table C.13 (Continued) Total crash models by functional classes for 1 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.048 (-5.53)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			-0.073 (-4.33)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.076 (-8.64)				
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction			1.250 (7.53)	0.885 (12.19)	
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					-0.664 (-2.84)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction	0.553 (4.76)		-0.885 (-11.26)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.015 (-2.42)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable				-0.928 (-8.31)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable			0.661 (5.37)	-0.883 (-14.93)	
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					0.806 (5.94)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-0.689 (-6.70)	
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable			-0.463 (-3.64)		
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.591 (-17.79)				
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.737 (8.37)			
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.512 (6.34)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.435 (2.54)				
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.575 (10.89)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	1.401 (8.15)	1.095 (11.33)		0.712 (37.57)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.343 (5.46)		

Table C.13 (Continued) Total crash models by functional classes for 1 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
MWD3040	Proportion of median width is in the 30.01 to 40.0 foot range, as continuous variable				-0.443 (-9.09)	
ALPHA	Dispersion parameter	0.041 (5.57)	0.013 (3.02)	0.055 (5.40)	0.010 (5.76)	0.017 (7.05)
Random Parameters						
Constant			1.728 (12.97)	0.852 (4.77)	2.382 (47.76)	3.614 (9.63)
LNADT	Natural log of AADT			-0.072 (-4.62)		
URBAN	Location indicator (if segment is located in in urban area, 1, otherwise, 0)					0.788 (32.14)
NHC	Count of horizontal curves within the fixed-length segment	-0.022 (-4.17)				0.082 (8.10)
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.055 (-5.56)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				-0.054 (-6.64)	
NVC	Count of vertical curves within the fixed-length segment	-0.052 (-7.91)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment				0.106 (14.27)	0.233 (20.59)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				-0.053 (-10.85)	
LVBSL68	Natural log of proportion ofvertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.144 (10.17)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.039 (4.64)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment					-1.116 (-10.33)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment					-0.830 (-6.81)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment					5.250 (11.04)
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	-1.114 (-12.76)				
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.639 (17.53)	1.070 (12.92)	0.687 (5.81)	0.992 (15.58)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.299 (13.62)
RDEC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in decreasing milepost direction, as continuous variable					-1.842 (-7.80)
RDEC2436	Proportion of roadway width is in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				-0.501 (-9.20)	
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.444 (-4.15)

Table C.13 (Continued) Total crash models by functional classes for 1 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		-1.607 (-19.36)			
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-1.004 (-14.33)		-0.460 (-13.09)	
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.155 (2.54)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.567 (-11.12)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.317 (-12.65)	0.417 (5.15)			
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.507 (5.89)			
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.488 (6.21)			
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.580 (-16.51)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.025 (-1.94)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.526 (7.26)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.592 (5.46)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	-0.733 (-4.07)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			1.012 (9.78)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.842 (4.57)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.202 (9.56)	0.562 (17.33)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant			0.581 (43.03)	0.482 (23.25)	0.452 (63.10)	0.378 (43.94)
LNADT	Natural log of AADT			0.002 (0.85)		

Table C.13 (Continued) Total crash models by functional classes for 1 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
URBAN	Location indicator (if segment is located in urban area, 1, otherwise, 0)					0.466 (26.58)
NHC	Count of horizontal curves within the fixed-length segment	0.030 (10.92)				0.031 (3.38)
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	0.129 (19.23)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				0.015 (2.14)	
NVC	Count of vertical curves within the fixed-length segment	0.029 (14.13)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment				0.073 (12.98)	0.135 (16.21)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.031 (9.97)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.170 (13.54)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.061 (12.70)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					0.047 (1.78)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					0.223 (2.68)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					8.198 (11.54)
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	0.476 (50.72)				
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.654 (57.28)	0.184 (13.79)	0.272 (12.84)	0.425 (56.07)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.126 (11.34)
RDEC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in decreasing milepost direction, as continuous variable					0.170 (11.01)
RDEC2436	Proportion of roadway width is in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				0.591 (38.73)	
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.130 (6.67)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		0.530 (28.63)			
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.841 (24.34)		0.468 (43.01)	

Table C.13 (Continued) Total crash models by functional classes for 1 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.100 (5.83)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.120 (5.06)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.064 (3.50)	0.137 (3.77)			
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.756 (15.45)			
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.163 (5.28)			
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					0.021 (2.25)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					0.047 (25.38)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.090 (1.59)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.160 (3.85)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	0.364 (19.42)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			1.048 (10.69)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.503 (26.59)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.252 (14.55)	0.466 (23.14)

The parameter and standard error estimates of the actual overdispersion parameter ($1/\psi$) is estimated using Taylor's series approximations, that give $EE(1/\psi\psi) \approx \frac{1}{EE(\psi\psi)} + \frac{\sigma\sigma^2_{\psi\psi}}{EE^3(\psi\psi)}$ and $\text{Var}(1/\psi\psi) \approx \frac{\sigma\sigma^2_{\psi\psi}}{EE^4(\psi\psi)}$.

Table C.14 Property damage only crash models by functional classes for 1 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LNADT	Natural log of AADT			-0.065 (-3.53)		
NHC	Count of horizontal curves within the fixed-length segment		-0.031 (-3.30)			
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment				-0.150 (-10.47)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.214 (6.91)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.064 (3.14)	0.205 (6.16)			
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	-0.094 (-2.81)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.072 (3.64)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.064 (-3.27)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					0.356 (4.28)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.182 (-7.32)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.054 (-4.56)	-0.099 (-6.53)			
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.058 (-3.33)		-0.114 (-4.50)	-0.057 (-6.00)	
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.103 (-4.22)				
NVC	Count of vertical curves within the fixed-length segment	-0.051 (-6.36)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	0.048 (3.82)				
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.116 (5.41)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.146 (8.76)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				-0.057 (-9.99)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.102 (6.57)				
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.063 (-5.87)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			-0.080 (-4.10)		
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	-0.590 (-3.41)				

Table C.14 (Continued) Property damage only crash models by functional classes for 1 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction	0.494 (3.15)			0.298 (4.08)	
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.855 (18.32)				
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					-0.975 (-3.44)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction			-1.011 (-10.41)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.015 (-2.05)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable	-0.642 (-2.94)				
RDEC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in decreasing milepost direction, as continuous variable	-0.531 (-2.56)		0.507 (6.88)	-0.184 (-4.96)	
RDEC2436	Proportion of roadway width is in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.847 (-4.18)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-1.098 (-19.67)	
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				-0.636 (-16.30)	
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.664 (-16.22)				
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable				-0.949 (-7.79)	
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.223 (3.12)		-0.907 (-9.78)	
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.231 (3.81)			
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.025 (-2.47)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.631 (5.12)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	-1.043 (-4.74)				
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.481 (7.35)			0.407 (5.18)	
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.939 (10.08)		0.498 (8.34)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.394 (5.34)	0.180 (7.11)	

Table C.14 (Continued) Property damage only crash models by functional classes for 1 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
MWD3040	Proportion of median width is in the 30.01 to 40.0 foot range, as continuous variable				-0.491 (-8.30)	
ALPHA	Dispersion parameter	0.033 (2.90)	0.021 (2.93)	374.075 (23724.26)	0.010 (4.99)	0.020 (6.56)
Random Parameters						
Constant		0.198 (0.91)	1.351 (8.81)	0.770 (4.72)	2.419 (31.22)	3.082 (6.74)
URBAN	Location indicator (if segment is located in urban area, 1, otherwise, 0)					0.843 (29.89)
NHC	Count of horizontal curves within the fixed-length segment	-0.039 (-5.75)				0.099 (8.61)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.073 (3.49)				
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.112 (-4.20)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment				-0.058 (-7.71)	
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment				0.090 (16.01)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.066 (4.09)			0.111 (12.98)	0.206 (16.01)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			-0.098 (-5.27)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.082 (-7.67)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.062 (5.98)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					-1.040 (-8.34)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					-1.033 (-7.38)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					3.788 (6.56)
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		1.266 (11.32)		0.324 (5.82)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.242 (9.71)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-1.734 (-6.03)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.318 (-2.49)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		-1.653 (-16.26)			

Table C.14 (Continued) Property damage only crash models by functional classes for 1 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-1.120 (-13.08)			
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.313 (4.43)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.441 (-7.46)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.396 (-12.59)				
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable				-0.623 (-8.11)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.468 (5.56)		-0.665 (-8.84)	-0.661 (-16.53)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.515 (5.47)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.917 (5.89)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	1.773 (14.26)		1.339 (11.57)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	1.210 (5.35)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.841 (22.65)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		0.738 (62.72)	0.710 (41.06)	0.599 (24.24)	0.159 (20.16)	0.233 (23.40)
URBAN	Location indicator (if segment is located in urban area, 1, otherwise, 0)					0.646 (32.22)
NHC	Count of horizontal curves within the fixed-length segment	0.042 (12.44)				0.122 (11.85)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.140 (8.33)				
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	0.131 (7.98)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment				0.110 (19.91)	
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment				0.092 (23.18)	

Table C.14 (Continued) Property damage only crash models by functional classes for 1 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.041 (3.69)			0.116 (17.67)	0.029 (3.14)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			0.025 (1.83)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.065 (8.44)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.078 (13.02)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					0.470 (6.58)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					0.373 (3.82)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					5.759 (7.51)
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		0.247 (14.86)		0.676 (71.12)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.156 (11.46)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.402 (23.94)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.056 (2.42)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		0.263 (11.67)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.739 (17.88)			
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.065 (3.39)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.124 (4.46)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.373 (16.59)				
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable				0.327 (12.04)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.707 (10.95)		0.565 (30.32)	0.104 (9.68)

Table C.14 (Continued) Property damage only crash models by functional classes for 1 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.298 (10.56)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.613 (20.74)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.775 (10.82)		0.941 (8.96)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.300 (12.93)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.541 (23.49)

Table C.14 (Continued) Property damage only crash models by functional classes for 1 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	9612	724	646	1214	3052
Number of Parameters	41	20	17	26	45
Number of Random Parameters	10	7	4	8	17
Restricted Log-Likelihood	-11446.38	-2056.21	-1302.59	-4433.46	-4364.98
Log-Likelihood	-11104.50	-1911.14	-1255.47	-4022.99	-4127.78
AIC	22288.99	3856.27	2536.95	8101.98	8343.55
BIC	22575.82	3934.21	2595.07	8244.82	8608.59
LL Ratio	683.77	290.15	94.24	820.94	474.40
Adjusted Pseudo R-squared	0.109	0.117	0.079	0.131	0.230
	RP NB	RP NB	RP NB	RP NB	RP NB

Table C.15 Possible injury crash models by functional classes for 1 mile segment

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.177 (5.11)			-0.104 (-4.61)	
NHCR710	Count of horizontal curves with 700 <= radius < 1000 (feet) within the fixed-length segment	-0.092 (-3.38)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	0.085 (3.42)		-0.108 (-2.82)		
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				-0.082 (-5.57)	
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment		0.152 (3.31)			
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.141 (12.44)	
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.126 (5.05)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment	-0.086 (-3.79)				
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.137 (5.01)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment		-0.107 (-6.41)			
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.036 (1.68)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					-1.689 (-8.12)
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	-1.214 (-24.35)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable				-0.494 (-8.39)	
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.473 (-2.88)
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable	-1.302 (-5.15)				
SDWL24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left side in increasing milepost direction, as continuous variable	-0.299 (-5.41)				
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.345 (-2.08)
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable		-0.910 (-5.43)			

Table C.15 (Continued) Possible injury crash models by functional classes for 1 mile segment

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWR10P	Proportion of travel shoulder width is wider than 10 ft. on the right side in increasing milepost direction, as continuous variable				1.059 (6.27)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.824 (-14.11)
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable			-0.751 (-6.29)		
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.545 (6.45)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	1.052 (7.20)				
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable					0.412 (6.17)
SSFRNA	There's no shoulder on the right side in increasing milepost direction within this segment	-1.511 (-4.19)				
ALPHA	Dispersion parameter				0.018 (3.09)	0.015 (2.60)
Random Parameters						
Constant		0.562 (2.69)	1.294 (7.39)	-0.219 (-2.21)	1.677 (35.12)	2.222 (4.03)
URBAN	Location indicator (if segment is located in urban area, 1, otherwise, 0)					0.828 (15.96)
NHC	Count of horizontal curves within the fixed-length segment					0.143 (8.85)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.165 (5.64)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.091 (-3.21)
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.099 (-3.36)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.048 (-1.59)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-0.085 (-3.92)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.067 (2.82)				0.212 (10.76)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		-0.072 (-3.53)			
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment				-0.047 (-4.26)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment				-0.049 (-5.11)	

Table C.15 (Continued) Possible injury crash models by functional classes for 1 mile segment

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.138 (-8.21)		-0.146 (-2.44)		
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		1.359 (8.35)			
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.462 (10.92)
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.025 (-2.73)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable			-0.989 (-5.88)	-1.339 (-15.48)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-2.258 (-6.38)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-1.153 (-4.48)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	-1.682 (-8.29)	-2.431 (-30.27)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-1.432 (-13.27)		-0.304 (-5.10)	
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.592 (-6.13)
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.812 (-9.91)				
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable				-1.190 (-14.12)	
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.206 (2.24)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.491 (7.63)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			0.860 (4.08)	0.540 (13.41)	
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable				-0.339 (-6.47)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.271 (5.78)	0.582 (10.92)

Table C.15 (Continued) Possible injury crash models by functional classes for 1 mile segment

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
Constant		0.938 (44.45)	0.749 (29.63)	0.603 (12.94)	0.637 (46.03)	0.202 (13.57)
URBAN	Location indicator (if segment is located in urban area, 1, otherwise, 0)					0.629 (21.66)
NHC	Count of horizontal curves within the fixed-length segment					0.128 (8.69)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.053 (2.19)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					0.215 (2.41)
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	0.035 (1.40)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	0.159 (6.86)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.119 (8.07)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.070 (3.77)				0.077 (5.72)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		0.051 (2.81)			
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment				0.119 (16.52)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment				0.046 (6.44)	
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.095 (7.31)		0.197 (4.55)		
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		0.089 (3.75)			
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.034 (1.76)
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					0.004 (9.92)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable			0.632 (5.80)	0.561 (7.55)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.494 (15.84)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					0.293 (11.11)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	0.081 (3.76)	0.496 (14.27)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.682 (12.22)		0.337 (16.54)	

Table C.15 (Continued) Possible injury crash models by functional classes for 1 mile segment

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.408 (8.23)
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	0.506 (7.54)				
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable				0.917 (14.34)	
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.235 (4.88)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.555 (11.36)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			1.281 (6.93)	0.059 (3.33)	
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable				0.460 (14.79)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.353 (11.14)	0.640 (18.33)

Table C.15 (Continued) Possible injury crash models by functional classes for 1 mile segment

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	9612	724	646	1214	3052
Number of Parameters	41	20	17	26	45
Number of Random Parameters	10	7	4	8	17
Restricted Log-Likelihood	-5753.38	-1729.58	-770.11	-3293.72	-2766.81
Log-Likelihood	-5348.02	-1342.09	-704.63	-3041.92	-2638.74
AIC	10750.05	2710.18	1429.26	6131.85	5351.47
BIC	10943.66	2769.79	1473.97	6254.29	5574.34
LL Ratio	810.72	774.97	130.95	503.59	256.15
Adjusted Pseudo R-squared	0.196	0.401	0.177	0.125	0.245
	RP Poisson	RP Poisson	RP Poisson	RP NB	RP NB

Table C.16 Evident injury crash models by functional classes for 1 mile segment

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
Constant				-1.350 (-2.22)		
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.268 (3.03)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.157 (3.08)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					0.537 (2.44)
NVBSL68	Count of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	-0.410 (-4.89)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment		0.108 (4.22)		0.061 (3.91)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment					0.130 (3.56)
LVASL24	Natural log of proportion of vertical curves with 2 <= absolute ahead slope < 4 within the fixed-length segment				-0.045 (-2.97)	
LVASL46	Natural log of proportion of vertical curves with 4 <= absolute ahead slope < 6 within the fixed-length segment	-0.049 (-2.69)			-0.062 (-3.65)	
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.049 (-2.24)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			-0.091 (-1.68)		
LVSP6065	Natural log of proportion of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	-0.107 (-3.46)				
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable	0.029 (2.78)	0.039 (4.31)	0.039 (1.83)		
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-2.203 (-4.72)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-1.080 (-3.60)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-0.786 (-4.32)	
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable			-1.136 (-4.45)		
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.563 (-3.41)
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.498 (-4.96)

Table C.16 (Continued) Evident injury crash models by functional classes for 1 mile segment

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.746 (2.59)
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	-0.476 (-4.80)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	0.563 (2.84)			0.808 (13.05)	
SSFRG	Proportion of shoulder surface type is gravel on the right side in increasing milepost direction, as continuous variable	-0.411 (-2.50)				
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable			0.925 (2.88)		
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			-0.997 (-2.81)		
MWD4050	Proportion of median width in 40.01 to 50.0 foot range, as continuous variable				-0.659 (-2.79)	
ALPHA	Dispersion parameter			13552.276 (90708.11)		0.866 (4.40)
Random Parameters						
Constant		-2.498 (-16.47)	-1.122 (-8.90)		-0.459 (-3.17)	3.979 (3.80)
URBAN	Location indicator (if segment is located in urban area, 1, otherwise, 0)					0.408 (4.96)
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	-0.231 (-3.64)				
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					-0.951 (-2.49)
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.247 (3.55)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.470 (5.07)		0.425 (2.20)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable				0.018 (4.53)	-0.059 (-3.37)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-3.307 (-5.02)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable			-0.813 (-1.99)		
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-0.540 (-3.13)		-0.433 (-5.61)	
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.069 (-2.12)

Table C.16 (Continued) Evident injury crash models by functional classes for 1 mile segment

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.695 (3.21)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					1.190 (3.93)
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.605 (3.13)			
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.556 (5.71)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		0.646 (26.16)	0.630 (15.25)		0.513 (21.23)	0.149 (5.54)
URBAN	Location indicator (if segment is located in urban area, 1, otherwise, 0)					0.452 (8.09)
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	0.205 (6.07)				
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					1.831 (6.67)
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.050 (1.43)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.376 (11.85)		0.466 (6.26)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable				0.009 (10.85)	0.001 (1.27)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.548 (10.17)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable			0.392 (2.22)		
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.576 (5.35)		0.224 (6.16)	
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					0.019 (3.31)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.297 (3.60)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.356 (4.09)
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.631 (7.29)			

Table C.16 (Continued) Evident injury crash models by functional classes for 1 mile segment

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.139 (2.40)

Table C.16 (Continued) Evident injury crash models by functional classes for 1 mile segment

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	9612	724	646	1214	3052
Number of Parameters	41	20	17	26	45
Number of Random Parameters	10	7	4	8	17
Restricted Log-Likelihood	-4450.29	-941.65	-496.04	-1985.71	-1732.54
Log-Likelihood	-4381.79	-878.70	-494.69	-1876.02	-1710.97
AIC	8791.58	1773.40	1011.39	3776.05	3483.93
BIC	8891.97	1810.08	1060.56	3837.27	3670.66
LL Ratio	136.99	125.91	2.69	219.38	43.15
Adjusted Pseudo R-squared	0.062	0.120	0.027	0.176	0.173
	RP Poisson	RP Poisson	RP NB	RP Poisson	RP NB

Table C.17 Serious injury crash models by functional classes for 1 mile segment

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
Constant			-2.117 (-15.08)			-1.432 (-3.55)
NHC	Count of horizontal curves within the fixed-length segment					0.158 (2.45)
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.302 (-2.32)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	0.224 (2.81)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.293 (-3.32)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.124 (2.78)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment		-0.111 (-1.73)			
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	-1.070 (-8.99)				
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				0.359 (2.00)	
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.314 (-1.93)				
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-1.059 (-4.32)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.447 (1.98)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable		1.082 (4.28)		0.613 (4.74)	
ALPHA	Dispersion parameter		2.265 (2.21)			1.200 (2.53)
Random Parameters						
Constant		-2.883 (-30.20)			-1.627 (-10.64)	
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					1.222 (2.31)
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.142 (2.80)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.094 (-2.13)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-0.632 (-2.06)

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.364 (-1.95)

Table C.17 (Continued) Serious injury crash models by functional classes for 1 mile segment

Random Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				-0.472 (-2.89)	
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		0.605 (11.48)			0.530 (10.15)	
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment					0.903 (1.83)
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.207 (5.34)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.106 (3.17)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.270 (2.25)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					0.682 (5.43)
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				0.295 (3.52)	

Table C.17 (Continued) Serious injury crash models by functional classes for 1 mile segment

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	9612			1214	3052
Number of Parameters	41			26	45
Number of Random Parameters	10			8	17
Restricted Log-Likelihood	-1483.39			-813.65	-609.94
Log-Likelihood	-1479.97			-806.76	-608.85
AIC	2981.93			1627.52	1241.70
BIC	3060.81			1663.23	1313.98
LL Ratio	6.84			13.79	2.18
Adjusted Pseudo R-squared	0.045			0.047	0.097
	RP Poisson			RP Poisson	RP NB

Table C.18 Fatal crash models by functional classes for 1-mile segment

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
Constant		-3.746 (-20.92)	-4.118 (-6.18)			-4.561 (-11.06)
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-0.233 (-1.88)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment		0.722 (2.51)			
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment					-0.413 (-2.11)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		0.817 (2.62)			
LVASL02	Natural log of proportion of vertical curves with absolute ahead slope < 2 within the fixed-length segment	-0.126 (-2.12)				
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-0.118 (-1.71)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment		-0.489 (-2.91)			
LVSP3035	Natural log of proportion of vertical curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.134 (-1.75)	-0.498 (-2.25)			
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	-0.856 (-4.97)				
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					0.050 (3.98)
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		1.248 (2.24)			
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		2.005 (3.18)			
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	3.987 (3.05)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	-5.496 (-2.33)				
Random Parameters						
URBAN	Location indicator (if segment is located in urban arear, 1, otherwise, 0)					0.578 (2.28)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					-4.088 (-2.36)
NVC	Count of vertical curves within the fixed-length segment		-0.710 (-2.76)			
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	0.340 (3.88)				
Standard Deviation for the Random Parameters with Normal Distribution						
URBAN	Location indicator (if segment is located in urban arear, 1, otherwise, 0)					0.169 (0.69)

Table C.18 (Continued) Fatal crash models by functional classes for 1-mile segment

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					2.905 (2.30)
NVC	Count of vertical curves within the fixed-length segment		0.181 (3.75)			
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	0.341 (5.95)				

Table C.18 (Continued) Fatal crash models by functional classes for 1-mile segment

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	646	1214			3052
Number of Parameters	17	26			45
Number of Random Parameters	4	8			17
Restricted Log-Likelihood	-835.35	-123.41			-311.11
Log-Likelihood	-831.35	-120.04			-310.86
AIC	1682.70	258.07			635.73
BIC	1754.41	299.34			677.89
LL Ratio	8.01	6.74			0.50
Adjusted Pseudo R-squared	0.033	0.113			0.061
	RP Poisson	RP Poisson			RP Poisson

Table C.19 Total crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
Constant		12.258 (5.15)				
AADT	AADT (ADTK10=AADT/10000)					0.140 (59.52)
NHC	Count of horizontal curves within the fixed-length segment		-0.088 (-6.84)			
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.057 (2.03)			-0.086 (-5.40)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.305 (9.96)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.088 (3.80)	0.355 (9.94)			
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.087 (-2.85)				
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	-0.066 (-1.59)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.117 (5.09)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.091 (-4.42)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					0.199 (3.96)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.221 (-6.54)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	0.040 (2.01)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment		-0.152 (-9.12)		-0.063 (-8.66)	
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.066 (-2.69)		-0.060 (-1.75)		
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.089 (-2.79)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.093 (-4.28)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	0.040 (2.39)			0.065 (9.95)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.085 (4.72)				
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.113 (4.66)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.093 (5.03)

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			-0.050 (-2.66)		

Table C.19 (Continued) Total crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.057 (-4.76)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			-0.070 (-3.20)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.130 (-11.71)				
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction			0.908 (4.66)	0.815 (13.25)	
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					-0.378 (-1.90)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction	0.449 (4.18)		-0.578 (-7.79)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.025 (-5.84)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable				-0.429 (-4.82)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable			-0.036 (-0.40)	-0.576 (-12.97)	
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.770 (-6.48)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-0.995 (-12.42)	
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable			-0.329 (-3.84)		
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.560 (-17.96)				
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.502 (6.05)			
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.747 (7.10)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	1.045 (8.86)				

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.483 (9.47)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	0.613 (4.92)	0.648 (6.66)		0.771 (46.07)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.142 (2.23)		
MWD3040	Proportion of median width is in the 30.01 to 40.0 foot range, as continuous variable				-0.419 (-10.09)	

Table C.19 (Continued) Total crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
ALPHA	Dispersion parameter	0.038 (4.06)	0.017 (2.30)	0.041 (2.43)	0.013 (6.23)	0.024 (7.90)
Random Parameters						
Constant			3.823 (14.86)	-4.273 (-10.87)	1.607 (36.63)	2.273 (8.58)
LNADT	Natural log of AADT			0.500 (11.53)		
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.377 (14.44)
NHC	Count of horizontal curves within the fixed-length segment	-0.028 (-3.17)				0.114 (9.41)
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.038 (-3.32)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				-0.052 (-4.35)	
NVC	Count of vertical curves within the fixed-length segment	-0.070 (-6.93)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment				0.108 (11.18)	0.191 (14.30)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				-0.103 (-19.67)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.251 (10.77)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.026 (2.74)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					-0.525 (-7.13)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					-0.565 (-6.92)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					4.226 (14.37)
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	-13.540 (-5.69)				

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.687 (19.04)	0.880 (10.79)	0.303 (1.88)	0.887 (16.49)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.267 (13.93)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-1.094 (-6.55)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				-0.341 (-8.51)	
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.448 (-5.92)

Table C.19 (Continued) Total crash models by functional classes for 0.5 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		-4.102 (-16.79)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-3.762 (-15.05)		-0.567 (-20.29)	
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.053 (-1.11)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.133 (-3.03)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.272 (-11.92)	0.182 (2.52)			
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.326 (4.32)			
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.334 (4.80)			
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.256 (-9.34)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.062 (-5.68)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.357 (5.43)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in					0.504 (5.95)

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
	increasing milepost direction, as continuous variable					
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	-0.725 (-4.06)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			0.998 (10.40)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.788 (4.32)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.103 (5.37)	0.205 (7.49)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant			0.731 (48.00)	0.183 (8.50)	0.724 (101.72)	0.293 (37.71)
LNADT	Natural log of AADT			0.074 (32.94)		

Table C.19 (Continued) Total crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.429 (27.69)
NHC	Count of horizontal curves within the fixed-length segment	0.049 (10.60)				0.079 (6.04)
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	0.029 (3.50)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				0.123 (11.02)	
NVC	Count of vertical curves within the fixed-length segment	0.037 (10.14)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment				0.000 (0.03)	0.107 (10.08)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.055 (14.00)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.270 (14.44)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.084 (13.66)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					0.084 (1.71)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					1.179 (19.17)

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					0.163 (0.59)
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	0.728 (79.82)				
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.509 (45.37)	0.474 (31.80)	0.034 (1.51)	0.460 (65.17)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.162 (15.38)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.287 (19.93)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				0.239 (19.59)	
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.283 (16.82)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		0.262 (15.83)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.290 (7.83)		0.287 (29.15)	

Table C.19 (Continued) Total crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.235 (14.70)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.076 (3.46)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.038 (2.23)	0.129 (3.73)			
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.260 (6.56)			
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.314 (11.11)			
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					0.091 (10.37)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					0.038 (23.66)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in					0.035 (1.57)

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
	increasing milepost direction, as continuous variable					
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.033 (0.97)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	0.459 (25.06)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			0.016 (0.21)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.163 (8.95)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.466 (28.66)	0.095 (5.85)

Table C.20 Property damage only crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
AADT	AADT (ADTK10=AADT/10000)					0.137 (32.33)
LNADT	Natural log of AADT			0.599 (11.62)		
NHC	Count of horizontal curves within the fixed-length segment		-0.100 (-6.22)			
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment				-0.113 (-5.99)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.259 (4.88)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.070 (2.31)	0.362 (8.30)			
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	-0.091 (-1.61)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.059 (1.27)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.136 (-3.50)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					0.114 (1.26)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.247 (-5.87)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.046 (-3.25)	-0.138 (-6.78)			
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.079 (-2.80)		-0.066 (-1.76)	-0.087 (-6.35)	
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.104 (-2.51)				
NVC	Count of vertical curves within the fixed-length segment	-0.065 (-5.14)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	0.023 (1.06)				
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.108 (3.52)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.080 (2.54)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				-0.112 (-18.54)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.141 (6.20)				
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.073 (-4.81)				

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			-0.060 (-2.42)		

Table C.20 (Continued) Property damage only crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	-13.372 (-4.73)				
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction	0.443 (3.01)			0.501 (7.72)	
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.847 (18.50)				
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					-0.593 (-2.44)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction			-0.710 (-7.74)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.036 (-4.96)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable	0.080 (0.37)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable	0.075 (0.35)		-0.248 (-2.86)	-0.187 (-6.16)	
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.935 (-4.82)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-1.070 (-16.47)	
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				-0.597 (-18.93)	
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.642 (-16.15)				
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable				-0.350 (-3.41)	
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.144 (2.23)		-0.556 (-6.61)	
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.234 (4.26)			
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.013 (-0.94)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.213 (1.72)

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	-0.968 (-4.54)				
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.369 (5.95)			0.309 (4.10)	

Table C.20 (Continued) Property damage only crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.548 (5.50)		0.705 (13.09)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.174 (2.31)	0.107 (4.69)	
MWD3040	Proportion of median width is in the 30.01 to 40.0 foot range, as continuous variable				-0.438 (-8.61)	
ALPHA	Dispersion parameter	0.065 (3.97)	0.023 (2.01)	0.051 (2.29)	0.013 (4.90)	0.317 (23.48)
Random Parameters						
Constant		11.600 (4.11)	3.756 (12.50)	-5.390 (-11.32)	1.284 (18.10)	3.451 (7.26)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.448 (11.96)
NHC	Count of horizontal curves within the fixed-length segment	-0.047 (-4.16)				0.131 (6.60)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	-0.008 (-0.24)				
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.110 (-2.74)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment				-0.054 (-6.11)	
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment				0.095 (12.30)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.085 (3.73)			0.113 (10.02)	0.204 (9.09)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			-0.083 (-3.77)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.123 (-8.57)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.037 (3.10)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					-0.555 (-5.05)

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.548 (5.50)		0.705 (13.09)	
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					-0.505 (-4.16)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					4.572 (4.61)
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		0.996 (9.28)		0.536 (10.55)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.272 (9.19)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-1.268 (-4.71)

Table C.20 (Continued) Property damage only crash models by functional classes for 0.5 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.604 (-4.61)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		-4.453 (-15.54)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-4.017 (-13.64)			
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.306 (-4.14)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.246 (-3.51)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.373 (-12.47)				
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable				-0.455 (-6.54)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.353 (4.05)		-0.376 (-5.50)	-0.231 (-4.62)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.168 (1.74)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.374 (2.55)

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.604 (-4.61)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	1.586 (14.21)		0.994 (8.55)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	1.045 (4.77)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.194 (3.69)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		0.807 (69.37)	0.803 (42.28)	0.775 (31.64)	0.770 (93.21)	0.868 (5.07)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.057 (1.90)
NHC	Count of horizontal curves within the fixed-length segment	0.067 (11.32)				0.010 (0.37)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.261 (9.20)				

Table C.20 (Continued) Property damage only crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	0.125 (5.14)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment				0.137 (18.62)	
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment				0.158 (25.35)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.002 (0.10)			0.091 (9.78)	0.026 (1.21)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			0.042 (2.29)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.033 (2.99)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.080 (10.14)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					0.041 (0.52)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					0.339 (3.95)

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	0.125 (5.14)				
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					1.196 (0.82)
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		0.266 (15.10)		0.262 (33.00)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.001 (0.06)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.008 (0.41)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.030 (1.04)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		0.262 (12.67)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.307 (6.90)			
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.011 (0.56)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.013 (0.38)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.373 (17.03)				

Table C.20 (Continued) Property damage only crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable				0.305 (11.61)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.878 (12.22)		0.575 (33.14)	0.035 (2.67)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.031 (0.82)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.048 (1.06)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.515 (8.39)		0.002 (0.02)		

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable				0.305 (11.61)	
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.209 (9.07)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.035 (0.98)

Table C.20 (Continued) Property damage only crash models by functional classes for 0.5 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	19316	1368	1202	2508	3054
Number of Parameters	40	17	13	28	44
Number of Random Parameters	10	5	3	7	16
Restricted Log-Likelihood (Fixed Parameters at Convergence)	-15747.44	-2873.18	-1879.56	-7788.07	-6906.38
Log-Likelihood	-15414.65	-2706.74	-1805.60	-7102.81	-6886.11
AIC	30909.31	5447.47	3637.20	14261.63	13860.21
BIC	31224.06	5536.23	3703.39	14424.79	14125.28
LL Ratio	665.58	332.88	147.91	1370.51	40.55
Adjusted Pseudo R-squared	0.088	0.080	0.091	0.127	0.204
	RP NB	RP NB	RP NB	RP NB	RP NB

Table C.21 Possible injury crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
AADT	AADT (ADTK10=AADT/10000)					0.149 (32.08)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	-0.081 (3.77)			-0.100 (-3.22)	
NHCR710	Count of horizontal curves with 700 <= radius < 1000 (feet) within the fixed-length segment	-0.086 (-1.96)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	-1.217 (2.88)		-0.120 (-2.37)		
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				-0.046 (-2.05)	
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment		0.223 (2.56)			
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.157 (10.57)	
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.069 (1.96)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment	0.641 (-2.26)				
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.020 (4.43)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment		-0.123 (-5.04)			
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.202 (0.66)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					-0.460 (-3.17)
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	0.207 (-24.69)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable				-0.376 (-7.91)	
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.539 (-3.85)
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable	-0.213 (1.58)				
SDWL24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left side in increasing milepost direction, as continuous variable	1.214 (-4.13)				
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.403 (-5.71)
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable		-0.737 (-4.77)			

Table C.21 (Continued) Possible injury crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWR10P	Proportion of travel shoulder width is wider than 10 ft. on the right side in increasing milepost direction, as continuous variable				0.738 (5.10)	
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.401 (-7.52)
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable			-0.482 (-4.27)		
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.197 (2.44)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	-0.941 (8.38)				
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable					-0.011 (-0.18)
SSFRNA	There's no shoulder on the right side in increasing milepost direction within this segment	-2.388 (-2.97)				
ALPHA	Dispersion parameter				0.025 (3.34)	0.042 (4.55)
Random Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
Constant		0.414 (-5.95)	2.841 (5.85)	-1.282 (-12.68)	0.869 (20.67)	1.076 (2.25)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.390 (6.75)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.123 (2.89)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.109 (-2.85)
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.025 (-1.49)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.142 (-0.47)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.070 (-1.35)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	1.035 (1.96)				0.181 (7.10)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		-0.196 (-4.18)			
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment				-0.115 (-9.69)	

Table C.21 (Continued) Possible injury crash models by functional classes for 0.5 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment				-0.043 (-3.71)	
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.042 (-6.23)		-0.228 (-2.63)		
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		1.156 (7.01)			
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.257 (6.30)
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.033 (-4.26)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable			-0.569 (-2.85)	-1.335 (-12.00)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-1.368 (-4.44)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-1.027 (-4.64)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	-0.855 (1.04)	-4.519 (-9.57)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-3.664 (-7.36)		-0.393 (-8.36)	
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.111 (-1.28)
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.071 (-10.15)				
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable				-1.025 (-13.11)	
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					-0.009 (-0.11)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.147 (2.42)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			1.533 (10.27)	0.642 (17.70)	
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable				-0.308 (-6.42)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.209 (4.98)	0.342 (6.91)

Table C.21 (Continued) Possible injury crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
Constant		0.090 (49.16)	0.851 (28.60)	0.912 (22.32)	0.793 (59.08)	0.276 (18.38)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.040 (1.42)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.005 (0.14)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					0.007 (0.22)
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	0.240 (0.31)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	0.107 (5.87)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.119 (7.49)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.119 (4.04)				0.200 (10.09)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		0.487 (11.47)			
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment				0.085 (9.58)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment				0.016 (1.64)	
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.171 (5.70)		0.002 (0.03)		
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		0.262 (9.39)			
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.395 (19.25)
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					0.003 (9.10)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable			0.512 (3.27)	0.826 (8.29)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.384 (12.02)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					0.371 (14.47)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	0.669 (4.20)	0.212 (6.46)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.104 (1.52)		0.300 (15.79)	
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in					0.152 (3.22)

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
	increasing milepost direction, as continuous variable					

Table C.21 (Continued) Possible injury crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	0.014 (10.21)				
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable				1.053 (17.62)	
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.002 (0.05)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.290 (6.47)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			0.101 (0.82)	0.002 (0.11)	
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable				0.634 (20.93)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.175 (6.00)	0.016 (0.57)

Table C.21 (Continued) Possible injury crash models by functional classes for 0.5 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	19316	1368	1202	2508	3054
Number of Parameters	27	13	10	24	38
Number of Random Parameters	8	5	4	9	14
Restricted Log-Likelihood (Fixed Parameters at Convergence)	-7270.34	-2029.36	-1000.08	-5496.53	-4025.48
Log-Likelihood	-6874.92	-1764.57	-915.17	-5113.23	-3938.60
AIC	13803.84	3555.15	1850.33	10274.46	7953.20
BIC	14016.29	3623.02	1901.25	10414.32	8182.12
LL Ratio	790.84	529.57	169.84	766.60	173.76
Adjusted Pseudo R-squared	0.141	0.178	0.155	0.115	0.252
	RP Poisson	RP Poisson	RP Poisson	RP NB	RP NB

Table C.22 Evident injury crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
Constant				-2.344 (-4.59)		
AADT	AADT (ADTK10=AADT/10000)					0.090 (11.22)
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.274 (2.80)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.192 (2.69)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					0.301 (1.70)
NVBSL68	Count of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	-0.400 (-3.34)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment		0.178 (3.78)		0.045 (1.86)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment					0.135 (2.82)
LVASL24	Natural log of proportion of vertical curves with 2 <= absolute ahead slope < 4 within the fixed-length segment				-0.056 (-3.07)	
LVASL46	Natural log of proportion of vertical curves with 4 <= absolute ahead slope < 6 within the fixed-length segment	-0.014 (-0.56)			-0.080 (-3.24)	
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.050 (-1.92)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			-0.187 (-3.01)		
LVSP6065	Natural log of proportion of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	-0.097 (-2.04)				
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable	-0.043 (-1.85)	0.025 (0.77)	0.043 (2.69)		
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-1.500 (-5.94)
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.685 (-3.69)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-0.648 (-3.19)	
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable			-0.829 (-3.56)		
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.164 (-1.05)
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.295 (-3.37)

Table C.22 (Continued) Evident injury crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
SDWRC68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.801 (3.01)
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	-0.514 (-5.28)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	0.964 (4.24)			0.853 (14.00)	
SSFRG	Proportion of shoulder surface type is gravel on the right side in increasing milepost direction, as continuous variable	-0.466 (-3.06)				
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable			0.595 (2.02)		
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			-0.814 (-2.59)		
MWD4050	Proportion of median width in 40.01 to 50.0 foot range, as continuous variable				-0.501 (-2.39)	
ALPHA	Dispersion parameter				0.124 (3.58)	0.066 (2.19)
Random Parameters						
Constant		-2.360 (-8.24)	-1.718 (-4.49)		-1.204 (-8.53)	1.718 (3.25)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.142 (1.54)
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	-0.229 (-2.44)				
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					-0.725 (-2.66)
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.184 (2.67)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.440 (4.90)		0.148 (0.76)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable				0.021 (5.34)	-0.046 (-5.17)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-2.057 (-6.12)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable			-0.579 (-1.53)		
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-0.319 (-1.00)		-0.454 (-5.94)	
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.113 (-4.00)

Table C.22 (Continued) Evident injury crash models by functional classes for 0.5 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.581 (3.05)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					1.277 (4.89)
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.189 (0.65)			
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.305 (3.26)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		0.739 (29.44)	0.743 (16.19)		0.576 (23.28)	0.007 (0.25)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.199 (3.63)
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	0.302 (6.19)				
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					0.745 (3.44)
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.356 (10.00)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.422 (13.20)		0.826 (10.83)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					0.000 (0.06)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.472 (9.42)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable			0.437 (1.85)		
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.042 (0.29)		0.374 (10.05)	
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					0.002 (0.35)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.271 (3.45)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.165 (2.06)

Table C.22 (Continued) Evident injury crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.507 (3.48)			
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.002 (0.03)

Table C.22 (Continued) Evident injury crash models by functional classes for 0.5 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	19316	1368	1202	2508	3054
Number of Parameters	14	8	10	13	31
Number of Random Parameters	3	3	2	3	10
Restricted Log-Likelihood (Fixed Parameters at Convergence)	-5530.38	-1078.23	-630.82	-2930.18	-2403.33
Log-Likelihood	-5474.60	-1050.19	-617.32	-2894.85	-2392.88
AIC	10977.20	2116.38	1254.63	5815.70	4847.75
BIC	11087.36	2158.15	1305.55	5891.46	5034.50
LL Ratio	111.56	56.08	27.00	70.66	20.92
Adjusted Pseudo R-squared	0.044	0.028	0.052	0.071	0.159
	RP Poisson	RP Poisson	RP Poisson	RP NB	RP NB

Table C.23 Serious injury crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
AADT	AADT (ADTK10=AADT/10000)					0.085 (4.99)
NHC	Count of horizontal curves within the fixed-length segment					0.012 (0.13)
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.305 (-1.37)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	0.205 (1.93)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.239 (-1.53)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.160 (2.58)	
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	-1.072 (-9.18)				
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				0.138 (0.84)	
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.244 (-1.54)				
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.809 (-3.68)
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.365 (1.56)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable				0.761 (6.11)	
ALPHA	Dispersion parameter					0.598 (2.07)
Random Parameters						
Constant		-3.576 (-41.10)			-2.324 (-14.90)	
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					1.222 (3.16)
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.238 (3.13)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.135 (-2.42)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-0.327 (-1.07)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.393 (-1.53)
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				-0.353 (-2.31)	

Table C.23 (Continued) Serious injury crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Constant		0.551 (10.46)			0.567 (11.23)	
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment					0.001 (0.00)
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.397 (7.50)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.007 (0.13)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.002 (0.02)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					0.871 (7.17)
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				0.021 (0.27)	

Table C.23 (Continued) Serious injury crash models by functional classes for 0.5 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	19316	1368	1202	2508	3054
Number of Parameters	11			7	11
Number of Random Parameters	3			2	3
Restricted Log-Likelihood (Fixed Parameters at Convergence)	-1755.24			-1110.86	-758.10
Log-Likelihood	-1751.99			-1106.89	-754.97
AIC	3525.98			2227.78	1531.94
BIC	3612.53			2268.57	1598.21
LL Ratio	6.50			7.94	6.26
Adjusted Pseudo R-squared	0.034			0.038	0.094
	RP Poisson			RP Poisson	RP NB

Table C.24 Fatal crash models by functional classes for 0.5 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
Constant		-4.320 (-30.31)	-4.261 (-8.68)			
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-0.087 (-0.45)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment		0.634 (1.82)			
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment					-0.435 (-1.65)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		0.491 (1.31)			
LVASL02	Natural log of proportion of vertical curves with absolute ahead slope < 2 within the fixed-length segment	-0.126 (-2.09)				
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.130 (1.15)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment		-0.207 (-0.93)			
LVSP3035	Natural log of proportion of vertical curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.159 (-1.39)				
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	-0.843 (-5.23)				
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					0.044 (3.57)
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.801 (1.67)			
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		1.564 (2.59)			
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	1.910 (0.47)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	-2.715 (-0.56)				
Random Parameters						
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					-0.126 (-0.40)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					-3.247 (-2.07)
NVC	Count of vertical curves within the fixed-length segment		-0.400 (-1.38)			
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	0.560 (3.63)				
Standard Deviation for the Random Parameters with Normal Distribution						
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					2.092 (5.95)

Table C.24 (Continued) Fatal crash models by functional classes for 0.5 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					2.646 (2.72)
NVC	Count of vertical curves within the fixed-length segment		0.001 (0.01)			
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	0.570 (6.66)				

Table C.24 (Continued) Fatal crash models by functional classes for 0.5 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	19316	1368	1202	2508	3054
Number of Parameters	10	8			7
Number of Random Parameters	1	1			2
Restricted Log-Likelihood (Fixed Parameters at Convergence)	-963.76	-150.54			-373.61
Log-Likelihood	-961.80	-145.15			-371.15
AIC	1943.59	306.31			756.29
BIC	2022.28	348.08			798.46
LL Ratio	3.93	10.77			4.93
Adjusted Pseudo R-squared	0.023	0.041			0.046
	RP Poisson	RP Poisson			RP Poisson

Table C.25 Total crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
Constant		1.845 (0.46)				
AADT	AADT (ADTK10=AADT/10000)					0.141 (66.09)
NHC	Count of horizontal curves within the fixed-length segment		-0.163 (-7.92)			
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.076 (1.96)			-0.138 (-6.25)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.348 (9.73)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.119 (3.71)	0.392 (8.35)			
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.098 (-2.23)				
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	-0.079 (-1.46)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.147 (4.96)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.090 (-3.61)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					0.048 (1.23)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.304 (-5.74)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	0.057 (1.85)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment		-0.154 (-7.32)		-0.086 (-8.68)	
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.062 (-1.60)		-0.133 (-2.65)		
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.064 (-1.43)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.079 (-2.53)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	0.053 (2.16)			0.129 (13.78)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.114 (4.93)				
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.139 (3.87)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.097 (4.31)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			-0.010 (-0.39)		

Table C.25 (Continued) Total crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.054 (-3.12)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			-0.011 (-0.30)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.121 (-7.64)				
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction			0.959 (5.14)	0.763 (14.53)	
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					-0.445 (-2.42)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction	0.335 (3.26)		-0.618 (-8.76)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.024 (-7.09)
RDEC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable				-0.466 (-5.99)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable			0.009 (0.10)	-0.573 (-16.65)	
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.692 (-7.63)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-0.726 (-10.45)	
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable			-0.250 (-3.10)		
SDWR02	Proportion of travel shoulder width is in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.530 (-17.76)				
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.377 (4.90)			
SDWRC810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.811 (9.50)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.564 (5.51)				
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.406 (8.42)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	0.983 (8.95)	0.370 (4.45)		0.779 (51.38)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.086 (1.43)		
MWD3040	Proportion of median width is in the 30.01 to 40.0 foot range, as continuous variable				-0.419 (-10.77)	

Table C.25 (Continued) Total crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
ALPHA	Dispersion parameter	0.027 (2.41)	0.021 (2.14)		0.013 (5.21)	0.030 (8.43)
Random Parameters						
Constant			2.019 (11.62)	-4.740 (-11.93)	0.957 (23.68)	1.485 (7.37)
LNADT	Natural log of AADT			0.459 (10.70)		
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.381 (15.14)
NHC	Count of horizontal curves within the fixed-length segment	0.018 (1.38)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.015 (-0.99)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				-0.066 (-3.95)	
NVC	Count of vertical curves within the fixed-length segment	-0.075 (-5.09)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment				0.110 (8.57)	0.222 (13.08)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				-0.069 (-10.65)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.322 (9.36)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.023 (2.00)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					-0.344 (-7.30)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					-0.434 (-8.06)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					3.001 (13.71)
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	-3.938 (-0.99)				
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.772 (22.00)	1.084 (13.78)	0.274 (1.74)	0.775 (17.01)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.261 (14.95)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-0.933 (-7.35)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				-0.325 (-10.98)	
RDEC3648	Proportion of roadway width is in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.393 (-6.76)

Table C.25 (Continued) Total crash models by functional classes for 0.25 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
RINC012	Proportion of roadway width is in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		-3.232 (-21.12)			
RINC1224	Proportion of roadway width is in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-2.611 (-16.71)		-0.526 (-22.28)	
SDWLC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.094 (-2.36)
SDWLC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.138 (-3.46)
SDWR24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.271 (-12.32)	0.226 (3.36)			
SDWR46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.273 (3.92)			
SDWR68	Proportion of travel shoulder width is in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.284 (4.38)			
SDWR810	Proportion of travel shoulder width is in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.287 (-12.04)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.075 (-8.40)
SDWRC46	Proportion of travel shoulder width is in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.387 (6.92)
SDWRC68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.588 (8.26)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	-0.666 (-4.09)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			1.242 (13.26)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.694 (4.16)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.080 (4.64)	0.189 (8.08)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant			0.936 (61.37)	0.468 (21.83)	0.860 (126.71)	0.424 (57.58)
LNADT	Natural log of AADT			0.081 (35.34)		
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.436 (30.34)
NHC	Count of horizontal curves within the fixed-length segment	0.001 (0.16)				

Table C.25 (Continued) Total crash models by functional classes for 0.25 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	0.012 (1.07)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				0.056 (3.53)	
NVC	Count of vertical curves within the fixed-length segment	0.061 (10.29)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment				0.065 (5.72)	0.134 (9.32)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.043 (8.10)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.341 (12.34)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.042 (5.06)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					0.171 (4.79)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					0.626 (14.33)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					0.045 (0.21)
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	0.910 (102.49)				
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction	0.307 (28.84)	0.309 (22.08)	0.026 (1.17)	0.380 (58.37)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.185 (19.06)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.380 (27.70)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				0.462 (41.85)	
RDEC3648	Proportion of roadway width in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.354 (23.24)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		0.313 (19.32)			
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.391 (12.26)		0.414 (44.40)	
SDWLC24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.065 (4.21)

Table C.25 (Continued) Total crash models by functional classes for 0.25 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWLC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.004 (0.21)
SDWR24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.236 (14.39)	0.065 (2.00)			
SDWR46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.230 (6.27)			
SDWR68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.172 (6.40)			
SDWR810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					0.001 (0.12)
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					0.041 (26.46)
SDWRC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.005 (0.24)
SDWRC68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.012 (0.38)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	0.339 (19.21)				
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			0.025 (0.36)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.220 (12.34)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.112 (7.74)	0.157 (10.74)

Table C.26 Property damage only crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
AADT	AADT (ADTK10=AADT/10000)					0.140 (56.94)
LNADT	Natural log of AADT			0.577 (11.12)		
NHC	Count of horizontal curves within the fixed-length segment		-0.185 (-7.07)			
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment				-0.141 (-5.34)	
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.332 (8.21)
NHCR57	Count of horizontal curves with 500 <= radius < 700 (feet) within the fixed-length segment	0.105 (2.52)	0.427 (7.23)			
NHSP4045	Count of horizontal curves with design speed of 40 mph or 45 mph within the fixed-length segment	-0.127 (-1.73)				
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.122 (3.58)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.105 (-3.67)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					-0.024 (-0.53)
LHCR1DW	Natural log of proportion of horizontal curves with radius less than 100 (feet) within the fixed-length segment	-0.332 (-5.09)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment	-0.015 (-0.83)	-0.181 (-6.84)			
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.034 (-0.75)		0.012 (0.21)	-0.087 (-4.46)	
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.073 (-1.27)				
NVC	Count of vertical curves within the fixed-length segment	-0.087 (-4.55)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment	0.043 (1.34)				
NVK250	Count of vertical curves with 20 < K value <=50 within the fixed-length segment	0.167 (3.65)				
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.113 (4.35)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				-0.090 (-11.76)	
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.202 (5.76)				
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.073 (-3.27)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			0.051 (1.10)		

Table C.26 (Continued) Property damage only crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
LNSDEC1	Proportion of 1-lane cross section in decreasing milepost direction, as continuous variable	-4.257 (-0.82)				
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction	0.380 (2.86)			0.409 (7.00)	
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.887 (19.76)				
LNSFINCB	Roadway surface type is bituminous in increasing milepost direction					-0.651 (-2.86)
LNSFINCP	Roadway surface type is portland cement concrete in increasing milepost direction			-0.734 (-8.31)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.024 (-5.97)
RDEC012	Proportion of roadway width in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable	-0.353 (-2.20)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable	-0.246 (-1.61)		-0.163 (-1.76)	-0.214 (-8.15)	
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.654 (-6.09)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-0.803 (-12.02)	
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				-0.582 (-21.40)	
SDWR02	Proportion of travel shoulder width in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.616 (-15.96)				
SDWR24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable				-0.313 (-3.16)	
SDWR46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right side in increasing milepost direction, as continuous variable		0.141 (2.33)		-0.453 (-5.89)	
SDWR68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.156 (3.01)			
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.003 (-0.40)
SDWRC68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.089 (1.33)
SSFLB	Proportion of shoulder surface type is bituminous on the left side in increasing milepost direction, as continuous variable	-0.827 (-4.31)				
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable	0.282 (4.87)			0.100 (1.50)	

Table C.26 (Continued) Property damage only crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.238 (2.84)		0.619 (12.99)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			0.117 (1.61)	0.089 (4.16)	
MWD3040	Proportion of median width in the 30.01 to 40.0 foot range, as continuous variable				-0.380 (-8.04)	
ALPHA	Dispersion parameter		0.034 (2.21)	0.072 (2.46)	0.014 (4.17)	0.033 (7.32)
Random Parameters						
Constant		2.171 (0.42)	1.863 (8.95)	-6.010 (-12.29)	0.760 (11.74)	1.077 (4.51)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.454 (15.58)
NHC	Count of horizontal curves within the fixed-length segment	-0.015 (-0.92)				
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.066 (1.47)				
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.076 (-1.38)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment				-0.097 (-8.38)	
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment				0.118 (10.41)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.120 (4.02)			0.132 (8.84)	0.235 (12.24)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			-0.045 (-1.43)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.127 (-6.21)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.028 (1.93)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					-0.308 (-5.68)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					-0.425 (-6.80)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					3.194 (13.06)
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		1.099 (10.58)		0.431 (9.20)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.246 (12.35)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-0.918 (-6.08)

Table C.26 (Continued) Property damage only crash models by functional classes for 0.25 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
RDEC3648	Proportion of roadway width in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.446 (-6.53)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		-3.423 (-18.57)			
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-2.724 (-14.42)			
SDWLC24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.318 (-7.51)
SDWLC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.229 (-5.04)
SDWR24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.351 (-12.37)				
SDWR68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable				-0.382 (-6.05)	
SDWR810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.199 (2.40)		-0.233 (-3.82)	-0.309 (-11.39)
SDWRC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.090 (1.60)
SDWRC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.144 (1.84)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	1.300 (13.69)		1.270 (10.84)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.817 (4.12)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.204 (7.66)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		0.918 (80.41)	0.940 (49.02)	0.940 (37.28)	0.970 (119.29)	0.539 (62.65)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.239 (14.86)
NHC	Count of horizontal curves within the fixed-length segment	0.002 (0.22)				
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.109 (2.79)				
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	0.083 (2.51)				
LHSP25DW	Natural log of proportion of horizontal curves with design speed <=25 (mph) within the fixed-length segment				0.011 (1.06)	

Table C.26 (Continued) Property damage only crash models by functional classes for 0.25 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment				0.161 (17.48)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.033 (1.40)			0.027 (2.05)	0.030 (1.82)
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment			0.056 (2.00)		
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.094 (5.63)				
LVSP70UP	Natural log of proportion of vertical curves with design speed more than 70 (mph) within the fixed-length segment	0.058 (5.46)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					0.051 (1.26)
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					0.418 (8.24)
PVK510	Proportion of vertical curves with 50 < K value <=100 within the fixed-length segment, as continuous variable					0.116 (0.50)
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		0.051 (2.96)		0.003 (0.37)	
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.107 (9.61)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.378 (23.81)
RDEC3648	Proportion of roadway width in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					0.415 (23.71)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable		0.426 (20.57)			
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.197 (5.04)			
SDWLC24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.083 (4.66)
SDWLC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.006 (0.23)
SDWR24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the right side in increasing milepost direction, as continuous variable	0.355 (16.75)				
SDWR68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable				0.249 (9.77)	
SDWR810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		0.779 (11.52)		0.382 (23.10)	0.054 (5.68)

Table C.26 (Continued) Property damage only crash models by functional classes for 0.25 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWRC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.036 (1.51)
SDWRC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.391 (15.68)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.596 (11.38)		0.017 (0.19)		
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	0.292 (12.86)				
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.002 (0.11)

Table C.26 (Continued) Property damage only crash models by functional classes for 0.25 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	38730	2844	2326	4918	6110
Number of Parameters	40	17	13	28	44
Number of Random Parameters	10	5	3	7	16
Restricted Log-Likelihood (Fixed Parameter at Convergence)	-20709.83	-4389.69	-2579.65	-12358.49	-10927.59
Log-Likelihood	-20334.58	-4159.33	-2473.12	-11302.89	-10515.58
AIC	40749.17	8352.66	4972.23	22661.77	21119.15
BIC	41091.74	8453.86	5047.01	22843.79	21414.73
LL Ratio	750.49	460.72	213.07	2111.20	824.02
Adjusted Pseudo R-squared	0.079	0.075	0.083	0.124	0.222
	RP NB	RP NB	RP NB	RP NB	RP NB

Table C.27 Possible injury crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
AADT	AADT (ADTK10=AADT/10000)					0.151 (36.01)
NHCA5DW	Count of horizontal curves with angle of deflection (Δ) <= 5 (degrees) within the fixed-length segment	0.242 (3.08)			-0.176 (-4.00)	
NHCR710	Count of horizontal curves with 700 <= radius < 1000 (feet) within the fixed-length segment	0.006 (0.10)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	0.129 (2.14)		-0.115 (-1.57)		
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment				-0.062 (-1.96)	
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment		0.228 (1.82)			
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.101 (4.84)	
NVK3040	Count of vertical curves with 300 < K value <=400 within the fixed-length segment					0.074 (1.71)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment	-0.175 (-3.01)				
LVBSL68	Natural log of proportion of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	0.201 (3.01)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment		-0.110 (-2.64)			
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.008 (0.16)				
PVBSL02	Proportion of vertical curves with absolute back slope < 2 within the fixed-length segment, as continuous variable					-0.269 (-2.98)
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	-1.234 (-25.25)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable				-0.356 (-8.44)	
RDEC3648	Proportion of roadway width in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.356 (-3.26)
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable	0.273 (0.91)				
SDWL24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left side in increasing milepost direction, as continuous variable	-0.205 (-4.13)				
SDWLC24	Proportion of travel shoulder width in the 2.01 to 4.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.401 (-6.45)
SDWR02	Proportion of travel shoulder width in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable		-0.620 (-4.08)			

Table C.27 (Continued) Possible injury crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWR10P	Proportion of travel shoulder width is wider than 10 ft. on the right side in increasing milepost direction, as continuous variable				0.667 (5.26)	
SDWR810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.419 (-9.07)
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable			-0.524 (-4.72)		
SDWRC68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.162 (2.19)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	1.203 (9.33)				
SSFRA	Proportion of shoulder surface type is asphalt on the right side in increasing milepost direction, as continuous variable					-0.095 (-1.88)
SSFRNA	There's no shoulder on the right side in increasing milepost direction within this segment	-0.941 (-3.17)				
ALPHA	Dispersion parameter				0.029 (3.23)	0.044 (4.02)
Random Parameters						
Constant		-2.788 (-9.38)	0.915 (2.80)	-2.053 (-20.27)	0.148 (3.86)	-0.203 (-0.55)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.418 (7.52)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.231 (4.05)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					-0.103 (-2.16)
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	-0.013 (-0.19)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	-0.032 (-0.41)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-0.043 (-0.97)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.044 (0.91)				0.176 (5.41)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		-0.150 (-2.45)			
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment				-0.135 (-8.95)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment				-0.073 (-4.27)	
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	-0.049 (-1.33)		-0.173 (-1.49)		
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		0.956 (5.95)			

Table C.27 (Continued) Possible injury crash models by functional classes for 0.25 mile segments

Random Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.251 (6.79)
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					-0.024 (-3.91)
RDEC012	Proportion of roadway width in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable			-0.905 (-3.46)	-0.807 (-6.63)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-0.898 (-3.76)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.738 (-4.31)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	0.021 (0.07)	-3.161 (-10.58)			
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-2.429 (-7.61)		-0.403 (-9.64)	
SDWLC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.061 (-0.77)
SDWR02	Proportion of travel shoulder width in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.747 (-9.54)				
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable				-0.947 (-13.29)	
SDWRC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					-0.052 (-0.69)
SDWRC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.102 (1.87)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			1.454 (9.39)	0.648 (19.43)	
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable				-0.353 (-7.78)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.192 (4.85)	0.352 (8.17)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		1.054 (50.78)	0.708 (25.19)	1.063 (23.17)	0.938 (69.87)	0.522 (35.74)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.073 (2.76)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.005 (0.09)
NHSP70UP	Count of horizontal curves with design speed more than 70 (mph) within the fixed-length segment					0.009 (0.23)

Table C.27 (Continued) Possible injury crash models by functional classes for 0.25 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
LHSP4045	Natural log of proportion of horizontal curves with design speed ranged from 40 to 45 (mph) within the fixed-length segment	0.006 (0.09)				
LHSP5055	Natural log of proportion of horizontal curves with design speed ranged from 50 to 55 (mph) within the fixed-length segment	0.385 (6.77)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.343 (9.91)				
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment	0.028 (0.65)				0.207 (7.55)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		0.349 (6.50)			
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment				0.005 (0.37)	
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment				0.019 (1.23)	
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.287 (9.74)		0.036 (0.33)		
LNSFDECA	Roadway surface type is asphalt in decreasing milepost direction		0.691 (24.10)			
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.327 (17.55)
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					0.000 (1.05)
RDEC012	Proportion of roadway width in the 0.01 to 12.0 foot range in decreasing milepost direction, as continuous variable			1.024 (5.35)	0.505 (4.34)	
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.209 (6.86)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					0.300 (12.49)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable	0.469 (22.48)	0.334 (10.33)			
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.503 (8.19)		0.056 (3.05)	
SDWLC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					0.063 (1.40)
SDWR02	Proportion of travel shoulder width in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	0.484 (7.50)				
SDWRC24	Proportion of travel shoulder width is in the 2.01 to 4.0 foot range on the right-center side in increasing milepost direction, as continuous variable				0.796 (14.32)	
SDWRC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.021 (0.49)

Table C.27 (Continued) Possible injury crash models by functional classes for 0.25 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWRC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.353 (8.61)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable			0.287 (2.24)	0.041 (2.71)	
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable				0.717 (24.23)	
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable				0.291 (10.41)	0.020 (0.78)

Table C.27 (Continued) Possible injury crash models by functional classes for 0.25 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	38730	2844	2326	4918	6110
Number of Parameters	27	13	10	24	38
Number of Random Parameters	8	5	4	9	14
Restricted Log-Likelihood (Fixed Parameter at Convergence)	-8871.68	-2839.35	-1240.81	-8162.42	-5910.24
Log-Likelihood	-8512.91	-2565.84	-1136.99	-7656.46	-5779.56
AIC	17079.82	5157.69	2293.97	15360.91	11635.12
BIC	17311.06	5235.08	2351.49	15516.93	11890.39
LL Ratio	717.54	547.00	207.65	1011.93	261.36
Adjusted Pseudo R-squared	0.112	0.132	0.131	0.108	0.250
	RP Poisson	RP Poisson	RP Poisson	RP NB	RP NB

Table C.28 Evident injury crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		TWLR	TWLU	NINTR	NINTU	INT
Variable	Description	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
Constant				-2.777 (-5.16)		
AADT	AADT (ADTK10=AADT/10000)					0.092 (12.48)
NHCR1015	Count of horizontal curves with 1000 <= radius < 1500 (feet) within the fixed-length segment					0.337 (2.95)
NHSP6065	Count of horizontal curves with design speed of 60 mph or 65 mph within the fixed-length segment					0.266 (2.82)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment					0.228 (1.82)
NVBSL68	Count of vertical curves with 6 <= absolute back slope < 8 within the fixed-length segment	-0.339 (-2.14)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment		0.199 (2.94)		0.087 (2.60)	
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment					0.078 (1.22)
LVASL24	Natural log of proportion of vertical curves with 2 <= absolute ahead slope < 4 within the fixed-length segment				-0.022 (-0.92)	
LVASL46	Natural log of proportion of vertical curves with 4 <= absolute ahead slope < 6 within the fixed-length segment	-0.027 (-0.76)			-0.069 (-2.05)	
LVK1020	Natural log of proportion of vertical curves with 100 < K value <=200 within the fixed-length segment	-0.055 (-1.58)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment			-0.063 (-0.57)		
LVSP6065	Natural log of proportion of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	0.004 (0.04)				
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable	-0.033 (-1.49)	0.013 (0.50)	0.032 (1.90)		
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-1.008 (-3.43)
RDEC3648	Proportion of roadway width in the 36.01 to 48.0 foot range in decreasing milepost direction, as continuous variable					-0.306 (-1.58)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable				-0.631 (-2.79)	
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable			-0.770 (-2.81)		
SDWLC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the left-center side in increasing milepost direction, as continuous variable					-0.180 (-1.28)
SDWR810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.381 (-4.77)

Table C.28 (Continued) Evident injury crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWRC68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.554 (2.64)
SSFRB	Proportion of shoulder surface type is bituminous on the right side in increasing milepost direction, as continuous variable	-0.463 (-4.72)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	0.791 (3.49)			0.836 (15.38)	
SSFRG	Proportion of shoulder surface type is gravel on the right side in increasing milepost direction, as continuous variable	-0.430 (-2.88)				
MSFA	Proportion of shoulder surface type is asphalt on the left side in increasing milepost direction, as continuous variable			0.497 (1.79)		
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable			-0.749 (-2.46)		
MWD4050	Proportion of median width in 40.01 to 50.0 foot range, as continuous variable				-0.526 (-2.71)	
ALPHA	Dispersion parameter			0.447 (2.25)		0.090 (2.02)
Random Parameters						
Constant		-3.319 (-12.05)	-2.399 (-7.94)		-1.731 (-14.18)	0.156 (0.25)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.102 (1.13)
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	-0.137 (-1.01)				
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					-0.328 (-1.77)
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.148 (2.29)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.538 (5.95)		0.140 (0.74)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable				0.014 (4.01)	-0.035 (-3.22)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-1.438 (-3.54)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable			-1.168 (-2.31)		
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		-0.238 (-0.89)		-0.486 (-7.34)	
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					-0.081 (-3.83)
SDWRC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.457 (2.89)

Table C.28 (Continued) Evident injury crash models by functional classes for 0.25 mile segments

Random Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
SDWRC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.901 (4.56)
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.264 (1.06)			
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.324 (3.84)
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		0.893 (35.41)	0.938 (20.00)		0.557 (24.57)	0.018 (0.68)
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					0.588 (10.56)
NVSP6065	Count of vertical curves with design speed ranged from 60 to 65 (mph) within the fixed-length segment	0.428 (6.30)				
PVBSL24	Proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment, as continuous variable					0.007 (0.04)
LNSFDECP	Roadway surface type is portland cement concrete in decreasing milepost direction					0.391 (11.03)
LNSFINCA	Roadway surface type is asphalt in increasing milepost direction	0.250 (7.92)		0.898 (12.04)		
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable				0.017 (22.51)	0.000 (0.22)
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.320 (6.61)
RINC012	Proportion of roadway width in the 0.01 to 12.0 foot range in increasing milepost direction, as continuous variable			1.363 (4.42)		
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable		0.008 (0.06)		0.419 (11.94)	
SDWRC	Weighted average travel shoulder width on the right-center side in increasing milepost direction, as continuous variable					0.046 (8.24)
SDWRC46	Proportion of travel shoulder width in the 4.01 to 6.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.091 (1.21)
SDWRC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.091 (1.17)
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable		0.070 (0.54)			
MWD1020	Proportion of median width in 10.01 to 20.0 foot range, as continuous variable					0.002 (0.04)

Table C.28 (Continued) Evident injury crash models by functional classes for 0.25 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	38730	2844	2326	4918	6110
Number of Parameters	14	8	11	12	30
Number of Random Parameters	3	3	2	3	10
Restricted Log-Likelihood (Fixed Parameter at Convergence)	-6645.07	-1427.11	-752.99	-4086.41	-3250.59
Log-Likelihood	-6595.57	-1388.13	-746.71	-3920.08	-3222.31
AIC	13219.15	2792.26	1515.42	7864.16	6504.62
BIC	13339.05	2839.88	1578.69	7942.17	6706.15
LL Ratio	98.99	77.96	12.56	332.66	56.56
Adjusted Pseudo R-squared	0.035	0.028	0.022	0.110	0.178
	RP Poisson	RP Poisson	RP NB	RP Poisson	RP Poisson

Table C.29 Serious injury crash models by functional classes for 0.25 mile segments

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
AADT	AADT (ADTK10=AADT/10000)					0.090 (5.82)
NHSP3035	Count of horizontal curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.296 (-1.00)				
LHCR50UP	Natural log of proportion of horizontal curves with 5000 <= radius (feet) within the fixed-length segment	0.146 (0.89)				
LHSP3035	Natural log of proportion of horizontal curves with design speeds of 30 mph or 35 mph within the fixed-length segment	-0.228 (-0.92)				
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment				0.127 (1.45)	
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	-1.094 (-9.34)				
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable				-0.091 (-0.60)	
SDWR02	Proportion of travel shoulder width in the 0.01 to 2.0 foot range on the right side in increasing milepost direction, as continuous variable	-0.213 (-1.38)				
SDWR810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable					-0.700 (-3.54)
SDWRC810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right-center side in increasing milepost direction, as continuous variable					0.350 (1.54)
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable				0.782 (6.43)	
ALPHA	Dispersion parameter				0.593 (2.57)	
Random Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
Constant		-4.309 (-52.40)			-2.840 (-18.18)	
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					0.713 (2.27)
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.481 (3.77)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.077 (0.73)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					-0.265 (-0.96)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					-0.334 (-1.42)

Table C.29 (Continued) Serious injury crash models by functional classes for 0.25 mile segments

Random Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				-0.587 (-3.81)	
Standard Deviation for the Random Parameters with Normal Distribution						
Constant		0.676 (12.91)			0.595 (11.47)	
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					0.002 (0.01)
LVK40UP	Natural log of proportion of vertical curves with 400 < K value within the fixed-length segment	0.601 (7.83)				
LVK510	Natural log of proportion of vertical curves with 50 < K value <=100 within the fixed-length segment	0.342 (4.43)				
RDEC1224	Proportion of roadway width in the 12.01 to 24 foot range in decreasing milepost direction, as continuous variable					0.001 (0.01)
RDEC2436	Proportion of roadway width in the 24.01 to 36.0 foot range in decreasing milepost direction, as continuous variable					0.843 (7.55)
RINC1224	Proportion of roadway width in the 12.01 to 24.0 foot range in increasing milepost direction, as continuous variable				0.461 (5.95)	

Table C.29 (Continued) Serious injury crash models by functional classes for 0.25 mile segments

	TWLR	TWLU	NINTR	NINTU	INT
Number of Observations (2014-2015)	38730			4918	6110
Number of Parameters	11			8	11
Number of Random Parameters	3			2	3
Restricted Log-Likelihood (Fixed Parameter at Convergence)	-2013.39			-1349.27	-911.88
Log-Likelihood	-2008.37			-1347.16	-910.57
AIC	4038.75			2710.32	1843.15
BIC	4132.96			2762.33	1917.04
LL Ratio	10.03			4.22	2.62
Adjusted Pseudo R-squared	0.029			0.030	0.076
	RP Poisson			RP NB	RP Poisson

Table C.30 Fatal crash models by functional classes for 0.25 mile segments.

Fixed Parameters						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
Constant		-5.022 (-42.15)	-5.212 (-12.02)			
NVBSL24	Count of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	-0.221 (-0.61)				
NVK1020	Count of vertical curves with 100 < K value <=200 within the fixed-length segment		0.636 (1.82)			
NVK2030	Count of vertical curves with 200 < K value <=300 within the fixed-length segment					-0.273 (-0.87)
NVK40UP	Count of vertical curves with 400 < K value within the fixed-length segment		0.507 (1.19)			
LVASL02	Natural log of proportion of vertical curves with absolute ahead slope < 2 within the fixed-length segment	-0.041 (-0.58)				
LVBSL24	Natural log of proportion of vertical curves with 2 <= absolute back slope < 4 within the fixed-length segment	0.080 (0.37)				
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment		-0.276 (-1.01)			
LVSP3035	Natural log of proportion of vertical curves with design speed of 30 mph or 35 mph within the fixed-length segment	-0.395 (-2.64)				
LNSFDECB	Roadway surface type is bituminous in decreasing milepost direction	-0.834 (-5.17)				
RWDDEC	Roadway weighted average width in decreasing milepost direction, as continuous variable					0.037 (2.97)
SDWR68	Proportion of travel shoulder width in the 6.01 to 8.0 foot range on the right side in increasing milepost direction, as continuous variable		0.847 (1.89)			
SDWR810	Proportion of travel shoulder width in the 8.01 to 10.0 foot range on the right side in increasing milepost direction, as continuous variable		1.503 (2.57)			
SSFLC	Proportion of curb shoulder surface type on the left side in increasing milepost direction, as continuous variable	0.514 (0.11)				
SSFRC	Proportion of curb shoulder surface type on the right side in increasing milepost direction, as continuous variable	-1.576 (-0.34)				
Random Parameters						
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					-0.030 (-0.10)
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					-2.497 (-1.74)
NVC	Count of vertical curves within the fixed-length segment		-0.186 (-0.56)			
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	0.393 (2.04)				
Standard Deviation for the Random Parameters with Normal Distribution						
URBAN	Location indicator (if segment is located in in urban arear, 1, otherwise, 0)					1.914 (5.75)

Table C.30 (Continued) Fatal crash models by functional classes for 0.25 mile segments

Standard Deviation for the Random Parameters with Normal Distribution						
Functional Class		**TWLR**	**TWLU**	**NINTR**	**NINTU**	**INT**
Variable	**Description**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**	**Coeff. (t-stat)**
PHCR2030	Proportion of horizontal curves with 2000 <= radius < 3000 (feet) within the fixed-length segment, as continuous variable					2.117 (2.78)
NVC	Count of vertical curves within the fixed-length segment		0.001 (0.01)			
LVK2030	Natural log of proportion of vertical curves with 200 < K value <=300 within the fixed-length segment	0.682 (6.64)				

Table C.30 (Continued) Fatal crash models by functional classes for 0.25 mile segments

	TWLR	**TWLU**	**NINTR**	**NINTU**	**INT**
Number of Observations (2014-2015)	38730	2844			6110
Number of Parameters	10	8			7
Number of Random Parameters	1	1			2
Restricted Log-Likelihood (Fixed Parameter at Convergence)	-1084.72	-178.01			-434.03
Log-Likelihood	-1082.39	-173.13			-431.63
AIC	2184.78	362.26			877.26
BIC	2270.43	409.89			924.29
LL Ratio	4.66	9.75			4.80
Adjusted Pseudo R-squared	0.020	0.036			0.033
	RP Poisson	RP Poisson			RP Poisson

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