

User's Manual • September 2013



Highway Safety Improvement Program IDOT HSM Crash Prediction Tool Version 3.0

Prepared for Illinois Department of Transportation • Bureau of Safety Engineering



State of Illinois Illinois Department of Transportation



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Acronyms and Abbreviations

ADT	average annual daily traffic
AADT	Average Annual Daily Traffic
BSE	Bureau of Safety Engineering
CMF	crash modification factors
EB	Empirical Bayes
HSM	Highway Safety Manual
IDOT	Illinois Department of Transportation
IDOT HSM Tool	Illlinois Department of Transportation Crash Prediction Tool
IRIS	llinois Roadway Information System
NCHRP	National Cooperative Highway Research Program
SPF	Safety performance function
SPFs	Safety Performance Functions

1.1 Overview

The National Cooperative Highway Research Program (NCHRP) 17-38 project deliverables included the development of briefing materials and a training course for highway agency analysts to assist them in understanding and using the Highway Safety Manual (HSM). As part of the project, three Microsoft Excel spreadsheets were developed to help analysts understand how to apply the crash predictive methods for different facility types included in Part C of the HSM. Predictive models for rural two-lane, two-way roads, rural multilane highways, and urban and suburban arterials are provided in HSM Chapters 10, 11, and 12.

The Illinois Department of Transportation HSM Crash Prediction Tool (IDOT HSM tool) has been created using the NCHRP 17-38 spreadsheets as a starting point, and provides a more robust and user-friendly interface for applying the three HSM Part C predictive methods.

This third version of the tool provides improved capabilities for analyzing roadway facilities. For example, the user can now choose to enter Average Annual Daily Traffic (AADT) information for each year or apply a growth factor. This manual provides step-by-step instructions for using the IDOT HSM tool. It also provides several example scenarios to assist the analyst in understanding use of the tool in project development.

The manual is organized into four chapters and two appendixes. Chapter 1 contains the introduction and new features of the tool. Chapter 2 provides examples of the tool new features. Chapter 3 provides examples of the application of each of the HSM predictive methods using the tool. Chapter 4 describes the utilities included in all modules. Appendix A contains the tab naming definition for all modules and Appendix B contains the troubleshooting section for Microsoft Office 2003.

1.2 Version Changes

Version 3.0 of the IDOT HSM tool includes the new features listed below:

- Incorporation of Illinois-specific calibration factors and crash distribution tables for Districts 1 and 2-9, and 2006-2008 and 2009-2011 study periods
- Improved user interface
- Ability to perform corridor analyses for up to 50 segment/intersection locations
- Ability to analyze up to 5 years of data
- Ability to apply a growth factor
- Improved summary sheets
- Additional data entry option using tabular format

1.3 Terminology

The following terms are critical for understanding the HSM Part C predictive method and are included here for the reader's reference:

- Safety performance function (SPF) An equation used to estimate or predict the expected average crash frequency per year at a location as a function of traffic volume and in some cases roadway or intersection characteristics (such as number of lanes, traffic control, or type of median).
- Calibration factor A factor to adjust crash frequency estimates produced from a safety prediction procedure to approximate local conditions. The calibration factor is computed by comparing existing

crash data at the state and regional levels to estimates obtained from predictive models. HSM does not distinguish between the state and local roadway system, and the calibration factor is not specific to the local system only or state system only. The calibration factor in this document is referred to as the "Illinois SPF calibration factor."

- Empirical Bayes (EB) methodology Method used to combine observed crash frequency data for a given site with predicted crash frequency data from many similar sites to estimate the expected crash frequency of the site.
- Predicted crash frequency The estimate of long-term average crash frequency, which is forecast to occur at a site using a predictive model found in HSM Part C. The predictive models in the HSM involve the use of regression models, known as SPFs, in combination with crash modification factors (CMFs) and calibration factors to adjust the model to site-specific and local conditions.
- Expected crash frequency The estimate of long-term expected average crash frequency of a site, facility, or network under a given set of geometric conditions and average annual daily traffic (AADT) volumes in a given period of years. In the EB methodology, this frequency is calculated from observed crash frequency at the site and predicted crash frequency at the site based on crash frequency estimates at other similar sites.
- Skew angle The base condition for intersection skew angle is zero degrees of skew (i.e., an
 intersection angle of 90 degrees). The skew angle for an intersection was defined as the absolute
 value of the deviation from an intersection angle of 90 degrees. The absolute value is used in the
 definition of skew angle because positive and negative skew angles are considered to have similar
 detrimental effect. Further information is provided in HSM Section 14.6.2.



Illustration of Intersection Skew Angle

Hazard Rating – The roadside hazard rating (a scale from 1 to 7) will be used to determine a roadside design CMF. Since this rating is a subjective value and can differ marginally based on the opinion of the assessor, it is reasonable to assume that a "homogeneous" segment can have a roadside hazard rating that varies by as much as two rating levels. An average of the roadside hazard ratings can be used to compile a "homogeneous" segment as long as the minimum and maximum values are not separated by a value greater than 2. For example, if the roadside hazard for a specific road rating ranges from 5 to 7, an average value of 6 can be assumed and this would be considered one homogeneous roadside design condition. If the roadside hazard ratings ranges from 2 to 5 (a range greater than 2), roadside conditions would not be considered "homogeneous" and smaller segments may be appropriate.

• Crash modification factor (CMF) -- An index of how much crash experience is expected to change following a modification in design or traffic control. CMF is the ratio between the numbers of crashes per unit of time expected after a modification or measure is implemented and the number of crashes per unit of time estimated if the change does not take place.

For any other terms not listed above, the reader may refer to the HSM glossary.

2.1 Incorporation of Illinois-specific Calibration Factors and Crash Distribution Tables

IDOT Bureau of Safety Engineering (BSE) has recently completed the calibration of the American Association of State Highway and Transportation Officials (AASHTO) HSM 1st Edition Safety Performance Functions (SPFs) for Illinois conditions. The calibration was conducted using state and local roadways information; therefore, the calibration factors can be applied to all routes. Calibration factors and crash distribution tables were developed for District 1 and Districts 2 to 9 and for study periods 2006-2008 and 2009-2011, resulting in four datasets:

- Dataset 1: District 1 Study Period 2006-2008
- Dataset 2: District 1 Study Period 2009-2011
- Dataset 3: Districts 2-9 Study Period 2006-2008
- Dataset 4: Districts 2-9 Study Period 2009-2011

For more information about the calibration process, please refer to the IDOT HSM Users Guide. All four datasets have been incorporated into the tool, and will be applied according to the input data used for the analysis as follows:

- If the analysis ends at or before 2008, either dataset 1 or 3 data will be used in the calculations.
- If the analysis starts at or after 2009, either **dataset 2 or 4** data will be applied. This dataset will be used for application of the predictive method with future volumes.
- **Crossover:** If the analysis starts before 2008 and ends after 2009, the analysis will be conducted as follows: The tool will run two analyses using both datasets (either 1 and 2, or 3 and 4). The tool will loop through the two datasets, generate two output files (export), and combine the results generating a combined summary file. The two output files will be saved in an **archive** folder under the same location where the tool is saved. The archive folder name will include the date and time of the analysis. For example, Archive_06102013_141550. Two files (named Archive_Period1.xlsm, and Archive_Period2.xlsm) will be located inside the folder. Each exported file will contain the background calculations for the different periods. The tool will contain information from both files, and will be combined into a summary sheet.

Figure 1 is a flowchart showing the different scenarios available for District 1.



FIGURE 1 District 1 Scenarios

The tool has been designed to update these values automatically, hence the user does not have to update them manually. After the analysis is completed, all the background calculations are available in the archive spreadsheets. Details on how to access the calibration factors and crash default tables are provided in the sections below and as part of the examples.

2.2 New Data Entry Overview

One of the major changes in this new version is the additional data entry option. This option allows the user to enter data for all segments and intersections in a table format to facilitate the data entry process.

2.2.1 Introduction

The following example demonstrates what steps are required to run an analysis using the new data entry option. This method is similar for all three modules (rural two-lane, rural multilane, and urban and suburban arterials).

STEP 1: Once the tool is open, the user will see the Disclaimer. After clicking **OK**, the Getting Started user form will open. The Getting Started window requires the user to input the **district** where the project is located, the **study period of analysis**, and the **facility type**. This information is required to start any analysis.

	Getting Started
1. Please s	select the District where this project is located.
Di	strict 1
C Di	strict 2 to District 9
2. What is	the study period of the analysis? (max 5 years)
From	2008
То	2012
3. What is	the facility type?
🔍 Ri	ural Two-Lane, Two-Way Roads
O RI	ural Multilane Highways
C Ur	ban and Suburban Arterials

STEP 2: The main menu user form will open. The main interface still maintains the original multiple-step process to run the analysis. A new button, **Load Input Data from Table**, has been added.

Rural Two-Lane, Two-Way Roads							
R		s Depart	ment of	Transportati	ion		
np Inp	out Data	Output D)ata				
	Load from Table	e _ S	itep 1	Step 2			
	Load Input Da from Table	ta New	Project	Project Information			
	Step 3	s	itep 4	Step 5			
	Segment Inpu	ut Interse	ction Input	Set up Spreadsheet			
AASH		E Sendori und anti-anti-anti-anti- anti-anti-anti-anti- anti-anti-anti-		Exit HSM Too	1		

STEP 3: Select the Load Input Data from Table button to display the input data user form.

Rural Two-Lane, Two-Way Roads Analysis Input						
Analysis Input :		-				
Total Number of Segments :	2	÷				
Total Number of Intersections :	2	÷				
Study Period : From	to					
Multiyear Analysis						
Apply Linear Traffic Growth Fac	tor (%)					
Enter AADT for Each Year	C					
Analysis Method						
Estimate Predicted Number of C	Crashes: O					
Estimate Expected Number of C	Crashes: O					
	Return to Main					

STEP 4: Input the information requested in the fields. Fields may vary according to the analysis type chosen. Details regarding each of the analysis types are provided in the examples included in Chapter 3.

The **Total Number of Segments** and the **Total Number of Intersections** should be a number between 0 and 50. For **Study Period**, enter the period for which crash data are available (for example, 2008 to 2012). The tool has been designed to handle a maximum of 5 years.

Multiyear analyses can now be conducted using either a growth factor or by entering AADT information for each analysis year. Multiyear analysis options will be enabled only when the difference between study period years is greater than 1. If **Apply Linear Traffic Growth Factor (%)** is selected, enter the respective value in percentage. If AADT for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text.

For this example, the study period is from 2008 to 2012 (which will be pre-populated). The analysis method selected is **Estimate Expected Number of Crashes** with EB adjustment using **Observed Crash Data by Site Available**. Details about the difference between the EB methods can be found in the HSM, Appendix A, Section A.2.1 (pages A-19 and A-20).

Once the user form is filled in, click Return to Main.

Rural Two-Lane, Two-Way Roads Analysis Input	×
Analysis Input : Total Number of Segments : 2	÷
Total Number of Intersections :	• •
Study Period : From 2008 to 201	2
Multiyear Analysis	0
Enter AADT for Each Year	•
Analysis Method	
Estimate Predicted Number of Crashes:	C
Estimate Expected Number of Crashes:	ſ
Analysis Report	~
Observed Crash Data by Site Available:	•
Observed Crash Data for the Project Available:	0
Return to Ma	in

STEP 5: A warning message appears providing instructions on the next steps as shown below. Click **OK** to continue.



STEP 6: The main interface closes, and two new tabs appear. Segment and intersection data are entered in these two tabs. The naming convention varies between different modules. TLR is for the two-lane rural roads, MLR is for multilane rural roads, and UrbArt is for Urban and Suburban Arterials. In this example, the **TLR_3_Seg_Input** and **TLR_5_Int_Input** tabs are used for data entry. The tabs are sequentially numbered and are displayed based on the type of analysis selected.

TLR_3_Seg_Input TLR_5_Int_Input 🖉

Data must be input only in color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. In the segment tab (**TLR_3_Seg_Input**), the top portion (Block 1) is where the project information is entered. This information is copied to the calculation and summary sheets. Block 2 includes the list of all the

variables required to apply the predictive method. Block 3 contains the facility Base Conditions (see HSM, Chapter 10 for details). Each column represents one facility (Block 4). In this case, there are two columns for the two segments. The tool is designed to analyze up to 50 segments.

Block 5 is for the observed crash data. These rows are visible because the **Estimate Expected Number** of **Crashes** analysis method was selected.

Block 6 is for the AADT data required to conduct a multiyear analysis. This is visible because the **Enter AADT for Each Year** option was selected as part of the Multiyear Analysis method (see Step 3).

State Route 260 R CC Consulting Inc IL 9/4/2013 District 3 2008 to 2012 SR 260	econstruction	
CC Consulting Inc IL 3/4/2013 District 3 2008 to 2012 SR 260		
Consulting Inc IL 9/4/2013 District 3 2008 to 2012 SR 260		
IL 9/4/2013 District 3 2008 to 2012 SR 260		
9/4/2013 District 3 2008 to 2012 SR 260		
District 3 2008 to 2012 SR 260		
2008 to 2012 SR 260		
SR 260		
511200		
\bigcirc		
Select Segment	Segment 1	Segment 2
	SR 260	SR 260
	MP 25.0.27.0	MP 27.0.29.0
	2	12
	12	12
6	8	8
Paued	Paved	Payed
Faveu	2.0	Faved
	2.0	
Net Deces	Net Decest	Mat Descent
Not Present	Not Present	NotPresent
	0.02	0
	2	2
	1.5	2
Not Present	Not Present	Not Present
Not Present	Not Present	Not Present
Not Present	Not Present	Not Present
3	4	4
Not Present	Not Present	Not Present
Not Present	Not Present	Not Present
	4	
	8	5
	10	6
DT Calculation Tab		
(i)i	
	Segment 1	Segment 2
	17,500	17,500
	17,700	17,700
	17,900	17,900
	18,100	18,100
	3 Select segment 6 Paved Not Present Not Present Not Present Not Present Not Present S DT Calculation Tab	3 Segment 1 SP 260 MP 26.0.27.0 MP 26.0.27.0 22 6 6 Paved Paved 9 200 Not Present Not Present DT Calculation Tab 6 Segment 1 17.500 17,900 17,900

				_		
Project Description			State	e Route 260 Re	econstruction	
Analyst			CC			
Agency or Company			Con:	sulting Inc		
State			IL			
Date Performed			9/4/2	2013		
Jurisdiction			Distr	ict 3		
Studu Period			2008	to 2012		
Boadway			SR 2	60		
Segment Name			Sel	lect Segment	Segment 1	Segment 2
Boadwau					SR 260	SR 260
Boadway Segment					MP 25.0.27.0	MP 27.0.29.0
Segment Length (mi)			-		2	12
Lane width (ft)			-		12	12
Shoulder width (ft)			-	6	12	16 6
Shoulder with (rt)			<u> </u>	Bauad	o Davad	o Daviad
Snoulder type			<u> </u>	Faveu	r aveu	Flaveu
Dedice of norizontal curve (mi)					2.0	
Radius of curvature (rt)					3500	No. December 1
Spiral transition curve (present/not present)				jot Present	Not Present	Not Present
Superelevation variance (Rrit)			<u> </u>		0.02	0
Grade (%)			<u> </u>		2	2
Driveway density (driveways/mile)			L		1.5	2
Centerline rumble strips (present/not present)			N	lot Present	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / n	iot present)]	<u> </u>	Jot Present	Not Present	Not Present
Two-way left-turn lane (present/not present)			<u> </u>	Jot Present	Not Present	Not Present
Roadside hazard rating (1-7 scale)				3	4	4
Segment lighting (present/not present)			<u>N</u>	lot Present	Not Present	Not Present
Auto speed enforcement (present/not present)			j N	lot Present	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed c	rashes/ye	ar)			2	1
PDO - Property Damage Only Crashes. (observed	l crashes/y	ear)			8	5
KABCO - Total Crashes (crashes/year)					10	6
MULTIYEAR ANALYSIS	3	Go to AA	DT Ca	alculation Tab		
Segment Name					Segment 1	Segment 2
AADT 2008					17,500	17,500
AADT 2009					17,700	17,700
AADT 2010					17,900	17,900
AADT 2011					18,100	18,100
AADT 2012					18,300	18,300
Neutous		t la rest t				
Next >>>	Prin	it input ir	110			
	_					
	Cra	sh By Ye	ear			

The user may select from three buttons:

- Next is used to advance to the next tab.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- Crash by Year is an optional button only used for the Estimate Expected Number of Crashes
 using Observed Crash Data by Site Available analysis method. This utility is used only if the user
 wants to document the crashes by year by segment in the spreadsheet. By clicking the button Crash
 by Year, additional rows at the bottom of the page will be unhidden and crash data for each segment
 included in the analysis, by severity levels for each study period year, can be entered.

In addition, a new button appears (**Upload Number of Crashes by Year**), which is used to populate the crash data input in the main input table.

1						
	Next >>>	Drint l	anut Info			
	MEAL PPP	FILL	iputino			
'						
		Currel	DuVern			
		Grash	By fear			
	Observed Crash Documer	ntatio	n			
1	Segment Name			Segment 1	Segment 2	
	KABC Crashes 2008					
i	KABC Crashes 2009					
i	KABC Crashes 2010					
'	KABC Crashes 2011					
ł	KABC Crashes 2012					
1				0	0	
I	Segment Name			Segment 1	Segment 2	
	PDO Crashes 2008					
	PDO Crashes 2009					
ĺ	PDO Crashes 2010					
	PDO Crashes 2011					
i	PDO Crashes 2012					
				0	0	
	Upload Nu	mber of	Crashes By Year			
	opiouuitu					

STEP 7: Click **Next** to go to the intersections tab (**TLR_5_Int_Input**). Similar to the segment tab, Block 1 is for the project information and Block 2 lists the variables required to apply the predictive method. Block 3 lists the predictive method Base Conditions. Block 4 is the data required for each intersection. Each column represents one facility. Block 5 is for the observed crash data broken down by severity type. Block 6 is for the AADT required to conduct a multiyear analysis. This option is visible only when the **Enter AADT for Each Year** option is selected.

Project Description	State Boute 260 Ben	onstruction	
Analust	CC	onstraution	
Agencii or Companii	Consulting Inc		
State 1	l l		
Date Performed	9/4/2013		
Jurisdiction	District 3		
Studu Period	2008 to 2012		
Boadwaii	SB 260		
	<u> </u>		
Intersection Name	elect Intersection	Intersection 1	Intersection 2
Boadwau		SB 260	SB 260 4
Major Road Name	11 1	SR 260	SR 260
Minor Road Name	1	Golf Rd	Louola St
Intersection type (3ST, 4ST, 4SG)	11	3ST	4ST
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?] (Yes/No)	No	No	Yes
Skew for Lea 1 (All)	. 0	0	15
Skew for Leg 2 (4ST only)	. 0	0	0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)	0	0	0
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)	0	0	. 0
Intersection lighting (present/not present)	Not Present	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		2	1
PDO - Property Damage Only Crashes, (observed crashes/year)	(5 12	6
KABCO - Total Crashes (crashes/year)		14	7
	\sim		
	(6)_		
Major Road		Intersection 1	Intersection 2
AADT 2008		17,500	17,500
AADT 2009		17,700	17,700
AADT 2010		17,900	17,900
AADT 2011		18,100	18,100
AADT 2012		18,300	18,300
Major Road		Intersection 1	Intersection 2
AADT 2008		7,000	3,500
AADT 2009		7,100	3,550
AADT 2010		7,200	3,600
AADT 2011		7,300	3,650
AADT 2012		7,400	3,700
	a Main		
Load Data Print Input Info Return to	owam		

Desires			Chaile Davids 200 David			
Project D	escription		State Houte 260 Heck	onstruction		
Analyst	Company		Concultion los			
Agency of Chata	rCompany		Consulting Inc			
Date Der	ormod		IL 94432012			
Date Ferr	ormed		District 2			
Stude Dor	iod		2009 to 2012			
Poodwar Roodwar	100		2000 (0 2012 CD 200			
noauway			on 200			
Interceptic	on Norma		Soloot Interception	Interception 1	Interception 2	
Boadwaii	Siriuame		Delectimetsection	SB 260	SB 260	
Maior Bo	ad Name			SB 260	SB 260	
Minor Bo	ad Name			Golf Bd	Louola St	
Intersectio	on tune (3ST, 4ST, 4SG)			3ST	4ST	
Intersectio	on skew angle (degrees) []F 49	ST. does skew differ for minor leas?] (Yes/No)	No	No	Yes	
		Skew for Leg 1(All)	0	0	15	
<u> </u>		Skew for Leg 2 (4ST onlu)	0	0	0	
Number o	f signalized or uncontrolled a	pproaches with a left-turn lane (0, 1, 2, 3, 4)	0 0	0	0	
Number o	f signalized or uncontrolled a	pproaches with a right-turn lane (0, 1, 2, 3, 4)	0	0	0	
Intersectio	on lighting (present/not prese	nt)	Not Present	Not Present	Not Present	
KABC - F	atal and Iniuru Onlu Crashes. ((observed crashes/uear)		2	1	
PDO - Pro	opertu Damage Onlu Crashes	(observed crashes/uear)		12	6	
KABCO-	Total Crashes (crashes/uear)		14	7	
		,				
N 41 11 1						
INUL	ITYEAR ANAL					
Maior Ro	ad			Intersection 1	Intersection 2	
AADT 20	08			17,500	17,500	
AADT 200	09			17,700	17,700	
AADT 201	10			17,900	17,900	
AADT 201	11			18,100	18,100	
AADT 201	12			18,300	18,300	
Major Ro	ad			Intersection 1	Intersection 2	
AADT 200	08			7,000	3,500	
AADT 20	09			7,100	3,550	
AADT 201	10			7,200	3,600	
AADT 201	11			7,300	3,650	
AADT 201	12			7,400	3,700	
	Load Data	Print Input Info				
		rintinputinio				
		Ore of De Verez				
		Crash By Year				

STEP 8: Once all the data have been input and reviewed, the next step is to set up the spreadsheets. Click on the **LOAD DATA** button to run the setup procedure.

Two additional buttons are at the bottom of the page:

Print Input Info is used to set the segment data input tab for printing using the Page Break View.

Crash by Year is an optional button. This utility is used only if the user wants to document the crashes by year and by segment in the spreadsheet. By clicking this button, additional rows at the bottom of the page will be unhidden and crash data for each segment included in the analysis, by severity levels for each study period year, can be entered. In addition, a new button appears (**Upload Number of Crashes by Year**) and is used to populate the crash data input in the main input table.

STEP 9: After the process is done running, a new window appears providing instructions about the next steps. It indicates what tab contains the summary sheet, and how to move forward with the analysis.

From this point forward, the steps are the same either using the original five-step process, or using the new **Load Data** option. Details about the five-step process are provided in Chapter 3.



2.3 Multiyear Analysis Applying Growth Factor

Another major change in the new version of the tool is the incorporation of a new method for conducting the multiyear analysis by applying a traffic growth factor. Originally, if the user wanted to conduct a multiyear analysis, AADT by year was a required data input. Annual AADT data are not always available; therefore, application of a growth factor will require entering data for 1 year only, and the tool will extrapolate the results of the predictive method by applying the growth factor.

2.3.1 Introduction

The following example demonstrates the steps required to run a multiyear analysis by applying a traffic growth factor. This method is similar for all three modules (rural two-lane, rural multilane, and urban and suburban arterials). The multilane rural roads predictive method is used in this example.

STEP 1: Enter the following data in the **Getting Started** user form. The project is located in District 1, study period is 2008-2012, and the facility is a Rural Multilane Highway. Click **Start Analysis**. **Note:** this example is also a crossover between the two study periods for which calibration factors have been developed (2006-2008 and 2009-2011).

	3
Getting Started	
1. Please select the District where this project is located. C District 1 C District 2 to District 9	
2. What is the study period of the analysis? (max 5 years) From 2008 To 2012	
3. What is the facility type? C Rural Two-Lane, Two-Way Roads Rural Multilane Highways Urban and Suburban Arterials	
Start Analysis	

STEP 2: The main menu user form will open up as s	shown below.
--	--------------



STEP 3: Select the New Project button. The Multilane Rural Roads Analysis Input user form will appear.

ultilane Rural Roads	Analysis Input	h	×
Analysis Input :			
Total Number of Div	rided Segments :	2	÷
Total Number of Un	divided Segments :	2	÷
Total Number of Int	ersections :	2	÷
Study Period :	From t	•	
— Multiyear Analys	is		
Apply Linear Tr	affic Growth Factor (%)		С
Enter AADT for	Each Year		С
Analysis Method			
Estimate Predic	ted Number of Crashes:		0
Estimate Expec	ted Number of Crashes:		С
	Re	turn to M	ain
	Ke	corn to M	

STEP 4: Enter the required data. For this example, two divided segments, two undivided segments, and four intersections will be analyzed. The study period (2008 to 2012) will be pre-populated. For the multiyear analysis, **Apply Linear Traffic Growth Factor (%)** is selected, and a value of 2 is used. The analysis method for this example is the **Expected Number of Crashes** using observed crash data at the project level. The total number of crashes for the project per year is 16. Once all the data are entered, click on **Return to Main**.

Aultilane Rural Roads Analysis Input	×
Analysis Input :	
Total Number of Divided Segments : 2	1
Total Number of Undivided Segments : 2	3
Total Number of Intersections :	3
Study Period : From 2008 to 2012	
Multiyear Analysis	
Apply Linear Traffic Growth Factor (%) 2	•
Enter AADT for Each Year	0
- Analysis Method	
Estimate Predicted Number of Crashes:	0
Estimate Expected Number of Crashes:	c
Analysis Report	
Observed Crash Data by Site Available:	0
Observed Crash Data for the Project Available:	e
Project Crashes	
Project Total Number of Crashes/Year: 16	
Return to Ma	in

STEP 5: Click on **Project Information** and enter details about the project. Once the form is filled up, select **Return to Main** to go back to the main menu.

Rural Multilane Highways	Multilane Rural Road Project Information						
	General Project Information						
(Illinois Department of Transportation	Project Description : Sample Corridor	Roadway : SR 27					
Input Data Output Data	Analyst : CC	State : IL					
Load from Table	Agency/Company: IDOT	Jurisdiction : D1					
Load Input Data from Table	Date (mm/dd/yyyy) : 09/04/2013	Study Period : 2008 to 2012					
Step 1 Step 2 Step 3 New Project Divided Segment	Divided Segment Project Information	Intersection Project Information					
Information Input	Roadway Section : MP 21.0	Major Road : SR 27					
Step 4 Step 5 Step 6	Undivided Segment Project Information	Minor Road : Golf Rd					
Segment Input Intersection Input Spreadsheet	Roadway Section : MP 23.0						
AASHID Exit HSM Tool		Return to Main					

STEP 6: Depending on the Analysis Input, enter the data. Yellow cells are hard coded values. Blue cells are dropdown menus with pre-set options. In this example, all facility types are included (divided and undivided segments, and intersections); to continue, click on the **Divided Segment Input** button. A new user form appears asking the user to choose the data input method. Data can be input either using user forms or in a table format. For this example, the **Read Data from Table** option is selected.

	ultilane Highways	lepartment of	f Transportat	ion	
	put buta ou	Load from Table Load Input Data from Table			
	Step 1 New Project	Step 2 Project Information	Step 3 Divided Segment Input		
Ę	Step 4 Undivided Segment Input	Step 5	Step 6 Set up Spreadsheet		Input Divided Segment Data
AA	5HP VIN		Exit HSM Too	ы	Enter Data Manually Read Data from Table

Once data entry is completed, select Return to Main.

Project Description	Sample Corridor								
Analyst	CC								
Agency or Company	IDOT								
State	L	1							
Date Performed	9/4/2013								
Jurisdiction	D1								
Study Period	2008 to 2012								
Roadway	SR 27								
Segment Name	Select Segment	Segment 1	Segment 2						
Length of Segment, L (mi)		1.2	0.8						
AADT (veh/day)		15,000	15,000						
Lane Width (ft)	12	12	12						
Shoulder Width (ft)	6	6	6						
Shoulder Type - Right Shoulder for Divided Segment	Paved	Paved	Paved						
Median Width (ft)		30	50						
Segment Lighting (present/not present)	Not Present	Not Present	Not Present						
Auto Speed Enforcement (present/not present)	Not Present	Not Present	Not Present						
Prin	nt Input Info Retu	Irn to Main							

STEP 7: Repeat the same process for undivided segments (if applicable). Select **Undivided Segment Input** and complete the data entry. Click **Return to Main** to go back to the main interface.



Project Description		Sample Con	ridor		
Analyst		CC			
Agency or Company		IDOT			
State		IL			
Date Performed		9/4/2013			
Jurisdiction		D1			
Study Period		2008 to 201	2		
Roadway		SR 27			
Segment Name		Select S	egment	Segment 1	Segment 2
Length of Segment, L (mi)				0.7	1.2
AADT (veh/day)				16,000	16,000
Lane width (ft)		1	2	12	2 12
Shoulder width (ft)		6		(6 6
Shoulder type		Pav	/ed	Paveo	l Paved
Side Slopes		1:	5	1:5	5 1:5
Segment lighting (present/not present)		Not Pr	resent	Not Present	Not Present
Auto speed enforcement (present/not present)		Not Pr	resent	Not Present	Not Present
	Drint In	nut Info	Potur	to Main	
	Phatin	putinio	Return	r to waln	

STEP 8: Select **Intersection Input** and complete the data entry. Click **Return to Main** to go back to the main interface.



Project Description				Sample Corridor					
Analyst				CC					
Agency or Company				IDOT					
State				IL					
Date Performed				9/4/2013					
Jurisdiction				D1					
Study Period				2008 to 2012					
Roadway				SR 27					
Intersection Name				Select Intersection	h	ntersection 1	Intersection 2	Intersection 3	Intersection 4
Intersection type (3ST, 4ST, 4SG)					3	IST	4ST	4SG	4ST
AADT _{major} (veh/day)						15,500	16,000	16,000	16,000
AADT _{minor} (veh/day)						1,500	4,000	5,000	1,500
Intersection skew angle (degrees)						0	0		
Number of signalized or uncontrolled approaches	with a left-turn lane (0,	, 1, 2, 3, 4)			0	0	0	0) (
Number of signalized or uncontrolled approaches	with a right-turn lane (0, 1, 2, 3, 4)			0	0	0	0	0
Intersection lighting (present/not present)				Not Present	١	Not Present	Not Present	Not Present	Present
	Print Input Info		Return	n to Main					
				the second se					

STEP 9: Once all the data entry is completed, select **Set up Spreadsheet**. This button will run the entire set-up process for the application of the predictive method.

Rural M	ultilane Highways		×
(T	put Data Out	epartment o tput Data	f Transportation
		Load from Table	
		Load Input Data from Table	
	Step 1	Step 2	Step 3
	New Project	Project Information	Divided Segment Input
	Step 4	Step 5	Step 6
	Undivided Segment Input	Intersection Input	Set up Spreadsheet
AAS	SHID VALUE		Exit HSM Tool

STEP 10: Once the process is finished running, a pop-up window will appear, providing the user with instructions on the next steps, and where to find results of the analysis. Click **OK** to continue, and close the main menu interface to go to the summary sheet.

	Rural Multilane Highways	x
Microsoft Excel	Illinois Department of Transportation	n
Based on the selected options, the tool has set up calculation and summary sheets. Calculation tabs can be seen by clicking the"Show Calculations"Button in the Main Menu - Output Tab.	Load from Table Load Input Data from Table	
For this analysis, secults can be found under the MLP O PuralMultil p Droi FP. Tot	Step 1 Step 2 Step 3	
tab Close the Main Menu user form using the "x"located in the top right corner, and	New Project Project Divided Segment Information Input	
proceed with reviewing the input data.	Step 4 Step 5 Step 6	
If you would like to go back to the Main menu, click on any of the "Return to Main"buttons located under the instructions and summary tabs	Undivided Segment Input Intersection Input Spreadsheet	
ОК	AASHID Exit HSM Tool	

STEP 11: Results can be found in Tabs **MLR_9_RuralMultiLn_Proj_EB_Tot** and **MLR_105_ProjEB_EXSum_GF**. Also, in the same location where the tool is saved, the user will find a new **Archive** folder containing the background calculations for the two study periods.

1_Start MLR_105_ProjEB_ExSum_GF _____MLR_9_RuralMultiLn_Proj_EB_Tot ____



12IVIHILL.	w	orksheet 5A I	Predicted and (Multilane Ru Observed Crash	ral Roads Summar	y Sheet Site Type Using	the Project-Leve	el EB Metho	1				-	F	Return to M
t CC						Roadway	SR 27						-		
or Company IDOT						Jurisdiction	D1								Hide Llouis
erformed 9/4/2013						Study Period	2008 to 2012								Rows
t Description Sample Corrid	or														
															LIGH ALD
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)		0	Jinide All R
	Predicted	average crash	frequency	Observed		Net	N _{w1}	We	No	W1	N ₁	Notcomb			
Site type		(crashes/year)		crasnes,	Overdispersion						<u> </u>				
	N predicted	N predicted	N predicted	Nobserved	Parameter, K	Equation A-8	Equation A-9	Equation	Equation	Equation	Equation	Equation			
	(TOTAL)	(FI)	(PDO)	(crashes/year)		(6)*(2)*	sqrt((6)*(2))	A-10	A-11	A-12	A-13	A-14			
ant 1 (Divided)	2 760	1 990	1 971	ROADW	AY SEGMENTS DIVI	2 504	0.916						-		
1 2008	3.609	1.009	1.071		0.177	2.304	0.810						-		
2-2009	3,685	1.850	1.835		0.177	2.404	0.808						1		
3 2010	3.759	1.888	1.871		0.177	2.501	0.816						1		
4 2011	3.834	1.925	1.909		0.177	2.603	0.824								
5-2012	3.911	1.964	1.947	-	0.177	2.708	0.832						-		
ant 2 (Divided)	2.431	1.221	1.210	-	0.266	1.5/1	0.803	-				-	-		
2 2009	2.334	1.174	1.100		0.266	1.508	0.787			-	-		-		
3 2010	2.431	1.221	1.210		0.266	1.569	0.803						1		
4 2011	2.479	1.245	1.234		0.266	1.632	0.811			-			1		
5 2012	2.529	1.270	1.259	-	0.266	1.698	0.820								
and different states in	4 103	0.500	4.000	ROADWA	Y SEGMENTS UNDIV	/IDED	4.007								
ent 1 (UNDIVIDED)	4.497	2.589	1.908		0.268	5.416	1.097		-	+	+				
2 - 2009	4.300	2,404	1.020		0.200	5 204	1.074		-	+			-		
3-2010	4.498	2.589	1.909	-	0.268	5.414	1.097			-	-		1		
4-2011	4.588	2.641	1.947		0.268	5.633	1.108					-	1		
5 2012	4.680	2.694	1.986		0.268	5.861	1.119]		
ent 2 (Undivided)	7.709	4.438	3.271		0.156	9.284	1.097								
1-2008	7.386	4.258	3.128		0.156	8.515	1.074								
2 2009 3 2010	7.500	4.351	3.209		0.150	9.921	1.080		-				-		
4 2011	7 865	4.430	3,338	-	0.156	9.657	1 108						-		
5 2012	8.023	4.618	3.405		0.156	10.047	1.119						1		
				· I	NTERSECTIONS										
ection 1	2.372	1.054	1.319		0.460	2.591	1.045								
1-2008	2.263	1.006	1.257		0.460	2.356	1.020						-		
2 2009	2.329	1.034	1.295		0.460	2.495	1.035						-		
4 2011	2.373	1.035	1.347	-	0.460	2,00	1.045	-	-				4		
5-2012	2.471	1.097	1.374		0.460	2.809	1.066						-		
ection 2	7.109	4.234	2.875		0.494	24.990	1.874						1		
1-2008	6.798	4.041	2.757		0.494	22.831	1.833]		
2-2009	6.975	4.156	2.819		0.494	24.033	1.856					-	-		
3 2010 4 2011	7.114	4.239	2.870		0.494	25.004	1.875						-		
4-2011	1.231	4.324	2.855		0.434	20.014	1.000		-				-		
Var.5 0040		7.400	1 4 4 4 0	1 0.000	+ +	0.404	07.005							I	
rears 2012		15 157	4.410	2.992		0.494	27.005	1.	912						
Year1 2008		14 549	5.807	8742		0.277	58.631	2.	043						
Year2 2009		14.857	5,908	8,949		0.277	61.143	2	029					-	
Year3 2010		15.154	6.026	9.128		0.277	63.613	2.	049					-	
Year4 2011		15.457	6.146	9.311		0.277	66.183	2.	069						
Year5 2012		15.766	6.269	9.497		0.277	68.857	2.	090						
Intersection 4		4.106	2.267	1.839		0.494	8.336	1.	424						
Year1 2008		3.926	2.164	1.762		0.494	7.616	1.	393						
Year2 2009		4.028	2.226	1.803		0.494	8.017	1/	411					-	
Years 2010		4.109	2.270	1.039		0.494	0.341	1.	420					-	
Year5 2012		4 275	2.362	1.070		0.494	9.028	1	453						
COMBINED (sum of r	column)	47 141	23 724	23.417	16		118 378	10	204	0.285	24.869	0.822	41 600	33,235	
COMDITIED (Sum of	columny	47.141	23.124	20.417	10		110.570	/ 10	.204	0.203	24.000	0.022	41.000	33.233	
		Works	heet 4B Pro	ject-Level EB M	ethod Summary R	esults									
Creat a supplit	(1)			(2)			(3)								
Crash severity level				N predicted			N expected								
Total			(2)0	ICOMB from Works	heet 5A	(13)	COMB from Works	sheet 5A							
				47.1			33.2								
Fatal and injury (FI)			(3)	In the second	heet 5A	(3) _{TOTAL} * (2) _{FI} / (2) TOTAL							
				23.7			16.7								
	V (PDO)		(4)	OMB from Works	heet 5A	(3)	TOTAL * (2)PDO / (2	2) _{TOTAL}							
Property damage only	,(100)														
Property damage onl	y(i D0)			23.4			16.5								

STEP 12: To print, export, make changes, or view the detailed calculations, return to the summary sheet tabs, and use the **Return to Main** button located in the top right corner.

	Illinois D	epartment o	f Transportatio	n
	<u> </u>	Load from Table		
	Step 1 New Project	Step 2 Project Information	Step 3 Divided Segment Input	
	Step 4 Undivided Segment Input	Step 5 Intersection Input	Step 6 Set up Spreadsheet	
AASHID Exit HSM Tool				

Once in the main menu, go to the Output Data tab to access the different utilities included in the tool.

(The second seco	put Data Out	epartment o put Data	of Transportation
à	Show Detailed Analysis	Show Calculations	Print Preview
R 4	Export Data	Edit/Change Analysis	Help
AASHID Exit HSM Tool			

Details about the different utilities included in the **Output Data** tab are provided in Chapter 4.

IDOT HSM Tool Application of the Predictive Methods

3.1 Rural Two-Lane, Two-Way Roads

3.1.1 Introduction

Chapter 10 of the HSM provides a methodology for estimating the predicted average crash frequency, crash severity, and collision types for rural two-lane, two-way facilities. This chapter is applicable to facilities with two-lane and two-way traffic operations that do not have access control or are outside of cities with a population less than 5,000 people. Details about the applicability of this module can be found in the HSM Section 10.3.

This example illustrates how to apply the Rural Two-Lane, Two-Way Roads predictive method using the IDOT HSM tool. It will also illustrate how to access the background calculations, and the calibration and crash default tables used in this analysis.

STEP 1: The screen capture below shows the opening page of the IDOT HSM tool. Click on the **Rural Two-Lane, Two-Way Roads** button to begin with the analysis.

1. Please	select the District where this project is located.
о п е п	iistrict 1 iistrict 2 to District 9
2. What i	s the study period of the analysis? (max 5 years)
From	2008
То	2012
3 What i	s the facility type?
(• F	ural Two-Lane, Two-Way Roads
C F	ural Multilane Highways
C L	Irban and Suburban Arterials

STEP 2: A new window opens and shows the main menu interface. The main menu is comprised of two main tabs: **Input Data** and **Output Data**. The Input Data tab opens by default when starting the tool. The output tab contains a series of utilities including print preview, export, among others. Details about the output tab utilities are provided in Chapter 4.

Rural Two-Lane, Two-Way Roads				
R	Illinois D	epartment of	Transportation	
np Inp	out Data Ou	tput Data		
	Load from Table	Step 1	Step 2	
<u>×</u>	Load Input Data from Table	New Project	Project Information	
	Step 3	Step 4	Step 5	
	Segment Input	Intersection Input	Set up Spreadsheet	
AASI	AASHO Ext HSM Tool			

Six buttons are displayed on the Input Data tab.

The user now has the ability to run the analysis using two methods. The first one is using the button **Load Input Data from Table** (described in Section 2.1), and the second one is following steps 1 through 5 (Five Step Process). Both methods produce the same results, but the first one is an abbreviation of the second method. Section 2.1 includes an example using the Load Data from Table process.

For illustrative purposes, this example will be conducted using the Tool's Five Step Process.

STEP 3: Click on the button labeled New Project. The Analysis Input user form will appear.



STEP 4: Input the information requested in the fields. The **Total Number of Segments** and the **Total Number of Intersections** should be a number between 0 and 50. The default number of segments and intersections is 2. The **Study Period** will be already pre-populated. This represents the period for which crash data are available (for example, 2008 to 2012). The tool has been designed to handle a maximum of 5 years.

Multiyear analyses can now be conducted using either a growth factor or entering AADT for each analysis year. An example with the application of growth factor is provided in Section 2.3. Multiyear analysis options will be enabled only when the difference between study period years is greater than 1. If **Apply Linear Traffic Growth Factor (%)** is selected, be sure to enter the respective value in percentage. If AADT for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text. If the latter is selected, a new window will open informing the user that AADT information for each year must be entered in Steps 3 and 4.

Analysis Method: If observed crash data are not available, select **Estimate Predicted Number of Crashes** by clicking on the circle next to the text. If observed crash data are available, select **Estimate Expected Number of Crashes** by clicking on the circle next to the text.

The expected crash frequency is obtained by applying the Empirical Bayes Method. This method combines the predicted average crash frequency with the observed crash data to provide a more reliable estimate. Selecting the **Estimate Expected Number of Crashes** option will enable the Analysis Report frame. There are two methods to apply the EB adjustment using observed crash data. The **Observed Crash Data by Site Available** option is used when available crash data are disaggregated by site (segments and/or intersections), and the **Observed Crash Data for the Project Available** option is used when observed crash data are only available at aggregated/project level across the all the sites.

Refer to HSM Sections A.2.4 and A.2.5 (Pages A-19 and A-20) for additional details on the different EB methods.

This analysis includes two segments and two intersections. The study period is from 2008 to 2012. The multiyear analysis will be conducted using AADT for each year. **Estimate Expected Number of Crashes** using **Observed Crash Data by Site** is the selected analysis method.

Rural Two-Lane, Two-Way Roads Analysis Input	
Analysis Input :	
Total Number of Segments :	
Total Number of Intersections : 2	
Study Period : From 2008 to 2012	
Multiyear Analysis	
Apply Linear Traffic Growth Factor (%)	
Enter AADT for Each Year 🙃	
Analysis Method	
Estimate Predicted Number of Crashes: O	
Estimate Expected Number of Crashes:	
Analysis Report	
Observed Crash Data by Site Available:	
Observed Crash Data for the Project Available:	Microsoft Excel
	Enter AADT for each year in Steps 3 and Step 4.
Return to Main	ОК

When complete, click on the $\ensuremath{\textbf{Return to Main}}$ button to return to the main input window.

STEP 5: On the main menu, select the button labeled Project Information.

Rural Two-Lane, Two-Way Roads				
1	Illinois D)epartment o	f Transportation	
np Inp	out Data Ou	Itput Data	-	
	Load from Table	Step 1	Step 2	
2	Load Input Data from Table	New Project	Project Information	
	Step 3	Step 4	Step 5	
	Segment Input	Intersection Input	Set up Spreadsheet	
Exit HSM Tool				

Rural Two-Lane, Two-Way Roads Project Information	×
General Project Information	
Project Description :	Roadway :
Analyst :	State :
Agency/Company:	Jurisdiction :
Date (mm/dd/yyyy) :	Study Period :
Segment Project Information	Intersection Project Information
Roadway Section :	Major Road :
	Minor Road :
L	
	Return to Main

STEP 6: Complete the information requested in the General Project Information input window. For Segments Project Information field, enter either a reference milepost or Key Route or Marked Route, or the reference milepost. Key Route refers to the Illinois Roadway Information System (IRIS) terminology and is a universal identifier for any segment. Marked Route refers to the Division of Traffic Safety route inventory. The key route information is not necessary for intersections, but all information provided will assist in tracking projects. For Intersection Project Information, enter a description for **Major Road** and **Minor Road** (for example, SR 27 and Cicero St, respectively). When all fields have been completed, click on **Return to Main**.

Rural Two-Lane.Two-Way Roads Project Information		×
General Project Information		
Project Description : ate Route 27 Reconstruction	Roadway :	SR 27
Analyst : CC	State :	IL.
Agency/Company: Consulting Inc	Jurisdiction :	District 3
Date (mm/dd/yyyy) : 09/04/2013	Study Period :	2008 to 2012
Segment Project Information	Intersection Project	t Information
Roadway Section : MP 21.0	Major Road :	SR 27
	Minor Road :	Cicero St
		Return to Main

STEP 7: Select the button labeled **Segment Input**.

Inp	out Data O	utput Data	
	Load from Table	Step 1	Step 2
	Load Input Data from Table	New Project	Project Information
	Step 3	Step 4	Step 5
	Segment Input	Intersection Input	Set up Spreadsheet

(NOTE: Depending on the analysis input data entered, there are instances when an additional user form appears asking about the data entry method.
	Enter Data Manually Read Data from Table
	Enter Data Manually: Data entry is performed one facility at a time using a user form.
	Read Data from Table: Data entry is performed for all facilities using a table (worksheet)

The main interface closes, and two new tabs appear. Segment and intersection data are entered in these two tabs. The naming convention varies between different modules. TLR is for two-lane rural roads, MLR is for multilane rural roads, and UrbArt is for Urban and Suburban Arterials. For this example, the **TLR_3_Seg_Input** and **TLR_5_Int_Input** tabs are used for data entry. The tabs are sequentially numbered, and are displayed based on the type of analysis selected.

```
H 1_Start TLR_3_Seg_Input TLR_5_Int_Input
```

STEP 8: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 1 provides details of the different variables needed to run the predictive method for segments.

	State Route 27 Rec CC Consulting Inc IL 9/4/2013 District 3 2008 to 2012 Cicero St	construction	
	CC Consulting Inc IL 9/4/2013 District 3 2008 to 2012 Cicero St		
	Consulting Inc IL 9/4/2013 District 3 2008 to 2012 Cicero St		
	IL 9/4/2013 District 3 2008 to 2012 Cicero St		
	9/4/2013 District 3 2008 to 2012 Cicero St		
	District 3 2008 to 2012 Cicero St		
	2008 to 2012 Cicero St		
	Cicero St	1	
	Select Segment	Segment 1	Segment 2
		SR 27	SR 27
		MP 21.0	MP 23.0
		0.8	12
		12	12
	6	6	6
	Paved	Paved	Paved
	Tarea		
	Not Present	Not Present	Not Present
	norresent		
		2	2
	Not Propert	Not Present	Not Present
411	Not Present	Not Present	Not Present
<u> </u>	Not Present	Not Present	Not Present
	2	NOT FIGSON	NUL FICSCIIL
	J Not Dropont	Not Present	J Not Present
	Not Present	Not Present	Not Present
ar)	Not Frederic	2	1
ar)		2	12
sar)		10	12
		10	10
	OT Calculation Tab		
	of calculation rap		
		Segment 1	Segment 2
		17,500	17,500
		17,850	17,850
		18,250	18,250
		18,650	18,650
		19,050	19,050
	ar) ar) ar)	Other beginnin 6 Paved Not Present Not Present Not Present Not Present Not Present Not Present ar) io to AADT Calculation Tab	Otoci Orginini SR 27 MP 21.0 0.8 12 6 6 6 Paved Paved Not Present Not Present Not Presen

Variable Name	Data Description
Segment name	Name of the roadway segment. Up to 50 segments
Length of Segment	Miles
AADT	AADT for roadway segment
Lane width	Feet
Shoulder width	Feet
Shoulder type	Paved, gravel, composite or turf
Length of horizontal curve	Miles
Radius of curvature	Feet
Spiral transition curve	Present or not present
Superelevation variance	Feet/feet
Grade	Percent
Driveway density	Driveways/mile
Centerline rumble strips	Present or not present
Passing lanes	Present (1 lane), present (2 lane) or not present
Two-Way Left-Turn lane	Present or not present
Roadside hazard rating	1-7 scale with 1 the safest and 7 the most dangerous
Segment lighting	Present or not present
Auto speed enforcement	Present or not present
Calibration factor	Derived from calibration process

TABLE 1 Rural Two-Lane Segment Data Needs

The user may select from three buttons:

- Return to Main is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- **Crash by Year** is an optional button only used for the Estimate Expected Number of Crashes using Observed Crash Data by Site Available analysis method. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet. By clicking this button, additional rows at the bottom of the page will be unhidden and crash data for each segment included in the analysis, by severity levels for each study period year, can be entered.

In addition, a new button (**Upload Number of Crashes by Year**), which is used to populate the crash data input in the main input table, appears.

	Crash By Ye	ar		
Observed Crash Document	ation			
Segment Name			Segment 1	Segment 2
KABC Crashes 2008				
KABC Crashes 2009				
KABC Crashes 2010				
KABC Crashes 2011				
KABC Crashes 2012				
Segment Name			Segment 1	Segment 2
PDO Crashes 2008				
PDO Crashes 2009				
PDO Crashes 2010				
PDO Crashes 2011				
PDO Crashes 2012				
	Upload Num	ber of Crashes	By Year	
	- production		-,	

After entering the data in the worksheet for both segments, click **Return to Main**.

STEP 9: Select the button labeled Intersection Input.

Rural Two-Lane, Two-Way Roads			x	
R	Illinois D	Department o	f Transportation	
np Inp	out Data Ou	Itput Data		
	Load from Table	Step 1	Step 2	
<u>k</u>	Load Input Data from Table	New Project	Project Information	
	Step 3	Step 4	Step 5	
	Segment Input	Intersection Input	Set up Spreadsheet	
AASI			Exit HSM Tool	

STEP 10: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 2 provides details of the different variables needed to run the predictive method for intersections.

TABLE 2 Rural Two Lane Intersections Data Needs

Variable Name	Data Description
Intersection name	Intersection Name. Up to 50 intersections
Intersection type	3ST, 4ST, 4SG
AADT major	AADT for major roadway segment
AADT minor	AADT for minor roadway segment
Intersection skew angle	Degrees
If 4ST, does skew differ from minor legs?	Yes or No
Skew angle for leg 1	Degrees
Skew angle for leg 2 (4ST Only)	Degrees
Signalized/Uncontrolled approaches with left turn lane	Between 0 to 4
Signalized/Uncontrolled approaches with right turn lane	Between 0 to 4
Intersection lighting	Present or not present
Calibration factor	Derived from calibration process

	OL 1 D 1 07 D	- 1 P	
Project Description	State Route 27 Recon	struction	
Analyst	00		
Agency or Company	Consulting Inc		
State			
Date Performed	9/4/2013		
Jurisdiction	District 3		
Study Period	2008 to 2012		
Roadway	Cicero St		
Intersection Name	Select Intersection	Intersection 1	Intersection 2
Roadway		SR 27	SR 27
Major Road Name		SR 27	SR 27
Minor Road Name		Cicero St	Golf Rd
Intersection type (3ST, 4ST, 4SG)		4ST	3ST
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?] (Yes/No)	No	No	No
Skew for Leg 1 (All):	0	0	0
Skew for Leg 2 (4ST only):	0	0	0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)	0	0	0
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)	0	0	0
Intersection lighting (present/not present)	Not Present	Not Present	Not Present
KABC - Fatal and Injury Only Crashes (observed crashes/year)		1	0
PDO - Property Damage Only Crashes (observed crashes/year)		5	7
KABCO - Total Crashes (crashes/year)		6	7
		-	
MULTIYEAR ANALYSIS			
Major Road		Intersection 1	Intersection 2
AADT 2008		17,500	17,500
AADT 2009		17,700	17,700
AADT 2010		17,900	17,900
AADT 2011		18,100	18,100
AADT 2012		18,300	18,300
Major Road		Intersection 1	Intersection 2
AADT 2008		3.500	1,800
AADT 2009		3,600	1,850
AADT 2010		3,700	1,900
AADT 2011		3.800	1,950
AADT 2012		3,900	2,000
Drink In making Defense for	Main		
Print input into Return to	wan		
Crash By Year			

Three buttons are at the bottom of the page:

- Return to Main is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- **Crash by Year** is an optional button only used for the Estimate Expected Number of Crashes using Observed Crash Data by Site Available analysis method. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet.

After entering the data in the worksheet for both intersections, click **Return to Main**.

IDOT HSM Crash Prediction Tool

Rural Two	Illinois Dout Data Out	epartment o tput Data	f Transportation
	Load from Table	Step 1	Step 2
	Load Input Data from Table	New Project	Project Information
	Step 3	Step 4	Step 5
	Segment Input	Intersection Input	Set up Spreadsheet
AASP		Handrich und se Seine Berger seine Standen Marinet (H	Exit HSM Tool

STEP 11: The last step in the process is to run the **Set up Spreadsheet** procedure. After the process is done running, a new window appears providing instructions about next steps. It indicates what tab contains the summary sheet, and how to move forward with the analysis. Click **OK**, and the main menu interface appears.

Microsoft Excel
Based on the selected options, the tool has set up calculation and summary sheets. Calculation tabs can be seen by clicking the"Show Calculations"Button in the Main Menu - Output Tab. For this analysis, results can be found under the TLR_7_Site EB Total tab Close the Main Menu user form using the"x"located in the top right corner, and proceed with reviewing the input data. If you would like to go back to the Main menu, click on any of the "Return to Main"buttons located under the instructions and summary tabs
ОК

Close the Rural Two-Lane, Two-Way Roads main menu by clicking on the **X** located in the top right corner of the user form.
IDOT HSM Crash Prediction Tool

Inp	out Data O	utput Data		
	Load from Table	Step 1	Step 2	
	Load Input Data from Table	New Project	Project Information	
	Step 3	Step 4	Step 5	
	Segment Input	Intersection Input	Set up Spreadsheet	

STEP 12: After closing the main menu, the predictive method summary is available, along with other tabs containing back up calculations.

1_1_Start / TLR_3_Seg Tables / TLR_3_Seg_Input / TLR_5_Int Tables / TLR_5_Int_Input / TLR_7_Site EB Total] TLR_91_SiteEB_ExSum /

For this example, the summary sheet is located in tab TLR_91_SiteEB_ExSum.

CH2MHILL			Two Lane R	ural Roads Exe	cutive Summa	y Sheet				Return to Main
	Worksheet 6	6A Predicted	and Expected C	rashes by Sev	erity and Site T	ype Using the S	Site-Specific EB	Method		
Analyst	CC				Roadway	Cicero St				Hide Unused
Agency or Company	Consulting Inc				Jurisdiction	District 3				Rows
Date Performed	9/4/2013				Study Period	2008 to 2012				
Project Description	State Route 27 R	leconstruction								
										Unhide All Row
	Tota	I Crashes Per	Year	Fatal and Ir	njury Crashes I	Per Year (FI)	roperty Damag	e Only Crashe	s Per Year (PDO	
Project	Predicted	Expected	HSM Potential	Predicted	Expected	HSM Potential	Predicted	Expected	HSM Potential	
Componente	average	average	for Safety	average	average	for Safety	average	average	for Safety	
componenta	crash	crash	Improvement	crash	crash	Improvement	crash	crash	Improvement	
	prodicted (TOTAL	N #XP#Ct#4 (TOTAL	(HSM PSI)	N prodicted (FI)	N expected (FI)	(HSM PSI)	N predicted (PDO)	N axpacted (PDO)	(HSM PSI)	
				SEGME	NTS					
Segment 1	5.8	7.4	1.6	1.9	2.4	0.5	3.9	5.0	1.1	
Segment 2	8.7	9.9	1.2	2.8	3.2	0.4	5.9	6.7	0.8	
				INTERSEC	TIONS					
Intersection 1	8.8	7.9	0.0	4.0	3.6	0.0	4.8	4.3	0.0	
Intersection 2	1.2	4.2	3.0	0.4	1.4	1.0	0.8	2.9	2.0	
COMBINED (sum of column)	24.5	29.4	4.9	9.1	10.5	1.4	15.5	18.9	3.4	
				N pre	beloted	N ex	peoled	HSM	A PSI	
Crash Severity Level				Predicted average crash frequency (crashes/yr)		Expected av	erage crash	HSM Pot	ential for	
						frequency	(crashes/yr)	Improvemen	t (crashes/yr)	
Fotal				24	4.5	2	9.4	4	.9	
Fatal and Injury (FI)				9.1		1	0.5	1	.4	
Property Damage Onl	operty Damage Only (PDO)			15.5 1/		8.9 3.4				



The user can navigate through the other tabs to make changes if needed. The predictive method calculations for each facility type are available and can be displayed using the utilities in the **Output Tab** in the main menu. Chapter 4 of this guide provides additional information regarding the different utilities available for all three modules.

Tab **TLR_7_SiteEB_Total**, contains the predicted, expected, and observed crashes for all facilities included in the analysis.

	4A Predict	ted and Obse	Two Lane Ru rved Crasher	iral Roads S : be Severite	ummary Sheet and Site Tup	Using the Site	-Specific EB	Method	
Analust	CC				Boadwau	Cicero St			
Agency of Company	Consulting Inc.				Jurisdiction	District 3			
	9/4/2013					2008 to 2012			
Date Performed	01412010	:			Study Period	2000 10 2012			
Project Description	State Route 2r	Reconstruction							
(0)		2	(2)	(1)	(5)	(6)	(2)	(9)	
		-2	191	[]4]		101	<u> </u>	Expected	
Site type		Predicted ; (verage crasi crashes/year	h frequency ')	Observed crashes, Natural	Overdispersio n Parameter, k	Veighted adjustment, V	average crash frequency,	
		N _{arra} sara (TOTAL)	N _{peratisted} (FI)	N _{erediated} (PDO)	(crashes/year)		Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix	
			ROA	DWAY SEGN	IENTS	•	rippendix	rippendix	
Segment 1		5.797	1.861	3.936	10	0.235	0.629	7.4	
Year1 2008		7.353	2.360	4.993	10	0.235			
Year2 2009		5.233	1.680	3.553	10	0.295			
Year3 2010		5.350	1.717	3.633	10	0.295			
Year4 2011		5.467	1.755	3.712	10	0.295			
Year5 2012		5.584	1.793	3.792	10	0.295			
Segment 2		8.696	2.791	5.305	13	0.197	0.718	9.9	
Year1 2008		11.030	3.541	7.489	13	0.197			
Year2 2009 Year3 2010 Year4 2011		7.849	2.520	5.329 5.449 5.568	13	0.197			
		8.025	2.576		13	0.197			
		8.201	2.632		13				
Year5 2012		8.377	2.689	5.688	13	0.197			
Interception 1		8 8 9 1	4 013	4 808	6	0.240	0.676	7.9	
Yeart 2008		9.678	4.015	5 6 9 3	6	0.240	0.010	1.9	
Year2 2009		8.311	3.865	3.020 A AA6	6	0.240			
Year3 2010		8508	3.356	4.552	6	0.240			
Year4 2011		8 705	4.048	4.657	6	0.240			
Year5 2012		8,903	4.140	4,763	6	0.240			
Intersection 2		1,223	0.393	0.829	7	0.540	0.481	4.2	
Year1 2008		1.618	0.515	1,104	7	0.540			
Year2 2009		1.087	0.351	0.736	7	0.540			
Year3 2010		1.112	0.359	0.753	7	0.540			
Year4 2011		1.136	0.367	0.769	7	0.540			
Year5 2012		1.160	0.375	0.785	7	0.540			
COMBINED (sum of	column)	24.537	3.058	15.479	36			29.397	
		Worksheet	4B Site-S	pecific EB M	ethod Sunna	ry Results			
C	[1] 		-	[2]			[3]		
Urash severity let	TEI		(2)00	N prediated	-h h # A	(8)007	Wengenled WR from Washel		
10(3)			(2)00	24.537	Sheet 4A		29.4	1000 4 A	
Fatal and Injury (FI)			(3)CO	MB from Work	sheet 4A	(3) _T	отац [*] (2) _{гі} / (2) т	TOTAL	
	(000)			9.058	1	10.9			
Property Damage Only (PDO)			(4)CO	IVIB from Work	sheet 4A	(3)TOTAL (2)PD0 / (2) TOTAL			

Three buttons on the top right side of the summaries can be used to return to the main menu, and to hide and unhide unused rows.

-	Return to Main	
_	Hide Unused Rows	
	Unhide Al Rows	

Worksheets (tabs) TLR_3_Seg_Input and TLR_5_Int_Input contain the input data used in this analysis.

Note: Worksheets TLR_3_Seg_Tables and TLR_5_Int_Input contain the HSM predictive method supporting tables. However, IDOT has developed state-specific values for all these different distributions and there is no need to use the HSM default values. Because this analysis crosses over the two

calibration datasets study periods, the state-specific values will be saved under the archive folder in the files **Archive_Period1.xlsm** and **Archive_Period2.xlsm**.

If needed, the IDOT HSM tool is flexible enough to allow modifications to such tables. Input data required from the user but restricted to **Yes** and **No** options are provided in the pull-down boxes (Blue cells). Orange cells contain the locally-derived data as shown in the graphics below.

The graphic below is a screen capture of the TLR_2_Seg_Tables of the Archive_Period1.xlsm file.

lables Affiliat	ted with Crash	Statistics:									
Table 10-3: [Distribution for (Crash Severity	Level on Run	al Two-Lane Tw	vo-Way Roadway Segments	plus Illinois-Sp	pecific Values				
Crash severity	/ level			Percenta	ige of total roadway segmen	t crashes					
Illinois-Spec	cific Values?	Yes	HS	M-Provided Val	ues Illin	ois-Specific V	alues				
Fatal				1.3		1.3					
Incapacitating	Injury			5.4		6.8					
Nonincapacitat	ing Injury			10.9		12.6					
Possible Injury				14.5		3.4					
Total Fatal Plu	s Injury			32.1		24.1					
Property Dama	ige Only			67.9		75.9					
TOTAL				100.0		100.0					
Note: HSM-provide	ed crash severitu data	based on HSIS dat	a for Washington (2	002-2006)							
Table 10.4	Default Distribu	tion by Collisi	on Type for Sr	ecific Crash Se	verity Levels on Rural Two I	ane Two Way	Roadway Seg	ments plus Illi	nois Specific		
Tuble To-4.	bendunt bistribu	uon by comin	on type for 5	cenie crush se	Values	and two-way	nouumuy seg	menta plua init	iois-specific		
				Perce	ntage of total roadway segm	ent crashes b	v crash severity	level			
				HSM-Provid	led Values		Illinois Sne	cific Values			
Collision type			Total fatal	Property	TOTAL (all severity levels	Total fatal	Property	TOTAL (all severity levels			
Illinois-Sper	cific Values?	Yes	and injury	damage only	combined)	and injury	damage only	comb	ined)		
SINGLE VEHIC	CLE CRASHES		ana ngarj	uunuge enij	compilion	una injurj	uunugo onij		inea		
Collision with a	nimal		3.8	18.4	12.1	7.5	52.4	41	1.5		
Collision with h	vicycle		0.4	0.1	0.2	0.3	0.0	0	1		
Collision with n	edestrian		0.7	0.1	0.3	0.9	0.0	0	2		
Overturned	Cucothan		37	1.5	2.5	24.8	6.9	11	2		
Ran off road			54.5	50.5	52.1	44.1	25.8	30	2		
Other single-ve	hicle crash		0.7	2.9	2.1	3.2	3.0	3	1		
Total single-veh	nicle crashes		63.8	73.5	69.3	80.8	88.1	86	.3		
MULTIPLE-VE	HICLE CRASHE	S									
Angle collision		_	10.0	7.2	8.5	1.3	1.1	1	.1		
Head-on collisi	on		3.4	0.3	1.6	3.9	0.4	1	2		
Rear-end collis	ion		16.4	12.2	14.2	6.0	3.4	4	.1		
Sideswipe colli	sion		3.8	38 37		3.6	3.0	3	.2		
Other multiple-	vehicle collision		2.6	3.0 2.7		4.4	4.0	4	.1		
Total multiple-v	nultiple-vehicle crashes 36.2 26.5 30.7		30.7	19.2	11.9	13	3.7				
TOTAL CRASH	IES		100.0	100.0	100.0	100.0	100.0	10	0.0		
Note: HSM-provid	ed values based on c	rash data for Washi	ngton (2002-2006)	; includes approximat	ely 70 percent opposite-direction sides:	ripe and 30 percer	nt same-direction side	swipe collisions.			
		Tab	le 10-12: Nigh	ttime Crash Pro	portions for Unlighted Roady	vay Segments	plus Illinois-Sp	ecific Values			
			HSM Defa	ault Values				Illinois-Specif	ic Values		
	. Illinois-Specific Values? Yes										
Roadway	Proportion of	total nighttim	e crashes by	1		Proportion	of total nighttim	e crashes bv	Proportion of	crashes that	cccur at
Type		severity level		Proportion of	crashes that occur at night		severity level			niaht	
	Fatal and		PDO page		Dor	Fatal and	I Injury Ding	PDO page		Dor	
2U	0.3	82	0.618	1	0.370	0	189	0.811		0.722	
Note: HSM-provid	ed values based on H	SIS data for Washin	aton (2002-2006)								
		the second									

The graphic below is a screen capture of the TLR_2_Seg_Tables of the Archive_Period2.xlsm file.

Tables Affilia	ted with Crash	Statistics:									
T 11 40.2 /		C 1 C 1									
Table 10-3: 1	Jistribution for	Crash Severity	Level on Rur	al Iwo-Lane Iv	vo-way Roadway Segments	plus Illinois-S	pecific values				
rash severity	level			Percenta	age of total roadway segmen	t crashes					
Illinois-Spe	cific Values?	Yes	HS	M-Provided Va	lues Illin	ois-Specific V	alues				
-atal				1.3		1.2					
ncapacitating	Injury			5.4		7.9					
Ionincapacitat	ing Injury			10.9		14.4					
ossible Injury				14.5		3.8					
otal Fatal Plu	s Injury			32.1		27.3					
Property Dama	ige Only			67.9		72.7					
TOTAL				100.0		100.0					
lote: HSM-provide	ed crash severity dat	ta based on HSIS da	ta for Washington (2	002-2006)							
Table 10-4:	Default Distrib	ution by Collisi	on Type for Sr	ecific Crash Se	everity Levels on Rural Two-L	ane Two-Wa	v Roadway Seg	ments plus Illir	nois-Specific		
		,			Values		,,,				
				Perce	entage of total roadway segme	ent crashes b	v crash severity	level			
				HSM-Provi	ded Values		Illinois-Spe	cific Values			
ollision type			Total fatal	Property	TOTAL (all severity levels	Total fatal	Property	TOTAL (all se	avority lovale		
Illinois-Spe	rific Values?	Yes	and injury	damage only	combined)	and injury	damage only	combined)			
INGLE VEHI		100	una injary	uunugo omj	combined	una injary	uunuge only	Conna	mouj		
Colligion with a	nimal		2.0	19.4	10.1	6.2	40.9	27	7.0		
Collision with bicycle			0.4	0.1	0.2	0.5	45.0	57	1		
Collicion with r	odoctrian		0.4	0.1	0.2	1.0	0.0	0.1			
Duarturnad	euestnan		2.7	0.1	0.5	1.0	7.3 11.7				
2 an off road			54.5	60.6	£2.5	47.0 27.5 32.9					
An on road	hiele crach		0.7	2.0	2.1	47.0	21.5	JZ.9 27			
Strier single-ve	hicle crash		62.9	72.5	60.2	2.1	97.2	2 95.6			
ILLI TIDI E VE		c c	03.0	13.5	03.5	00.5	07.5	00).0		
VIOL TIFELE-VE	IIICEL CRASH	L 3	10.0	7.2	8.5	12	13	1	3		
Angle collision			2.4	0.2	1.0	2.6	0.6 1.5				
Head-on collision			3.4	0.5	14.0	5.0	0.0	0 1.4			
Rear-end collision		10.4	3.9	3.7	3.7	4.0	4.0				
Sideswipe collision		2.6	3.0	2.7	3.1 A E	4.2	2.9				
Total multiple-vehicle crashes		2.0	26.6	20.7	4.5	4.2	4.5				
OTAL CRASHES 10		100.0	20.5	100.0	100.0	100.0	14.5				
UTAL CRASI	IL3		100.0	100.0	100.0	100.0	100.0	10	0.0		
lote: HSM-provid	ed values based on	crash data for Washi	ington (2002-2006)	; includes approximal	tely /Upercent opposite-direction sides	wipe and 3U percei	nt same-direction side	swipe collisions.			
		lat	ole 10-12: Nigh	ttime Crash Pro	portions for Unlighted Road	way Segment	s plus Illinois-Sp	ecific Values			
			HSM Defa	ult Values				Illinois-Specif	ic Values		
Roadway	Illinois-Spe	cific Values?	Yes								
Type	Proportion of	of total nighttim	ne crashes by			Proportion	of total nighttim	e crashes by	Proportion o	f crashes that	: occu
.160		severity level		Proportion of	f crashes that occur at night		severity level			night	
	Fatal and	l Injury p _{inr}	PDO ppnr		Pnr	Fatal and Injury pinr PDO ppnr			Pnr		
2U	0.	382	0.618		0.370	0	.208	0.792		0.715	
Note: HSM-provid	ed values based on	HSIS data for Washir	ortop (2002-2006)								

STEP 13: To print the summary, export data, or make changes, click on the **Return to Main** button on the top right side of the summary tabs. This will prompt the main menu. Click on the **Output Data** tab.

Rural Two-Lane,	Two-Way Roads	partment of	f Transportatio	n
Input I	Data Out	Show	Print Preview	
E:	Analysis	Edit/Change Analysis	Help	
			Exit HSM Tool	

The following buttons are then available:

- Show Detailed Analysis: Displays the background summary calculations.
- Show Calculations: Displays the predictive method calculations (tabs) for each facility included in the analysis. Note: If the analysis is a crossover, after clicking this button, a new window will open up with instructions on how to find the calculations.



- **Print Preview:** Prepares the summary sheet for printing.
- Export Data: Creates a copy of the spreadsheet.
- Edit/Change Analysis: Allows the user to make changes, including adding facilities, changing values, and re-running the set-up process.
- Help: Provides a hyperlink to the IDOT HSM Tool User's Manual posted on IDOT website.

Details about these utilities are provided in Chapter 4.

3.2 Rural Multilane Highways

3.2.1 Introduction

Chapter 11 of the HSM provides a methodology for estimating the predicted average crash frequency, crash severity, and collision types for rural multilane highways. This chapter is applicable to all multilane highways without full access control that are outside urban areas with a population less than 5,000 people. Details about the applicability of this module can be found in the HSM Section 11.3.

This example illustrates how to apply the Rural Multilane Highways predictive method using the IDOT HSM tool.

STEP 1: The screen capture below shows the opening page of the IDOT HSM tool. For this example, the project is located in District 2. The study period of analysis is 2009-2012, and the facility type is Rural Multilane Highway.

 Please select the District where this project is located. District 1 District 2 to District 9 What is the study period of the analysis? (max 5 years From 2009 To 2012 What is the facility type? Rural Two-Lane, Two-Way Roads Rural Multilane Highways Urban and Suburban Arterials
 C District 1 (* District 2 to District 9 2. What is the study period of the analysis? (max 5 years From 2009 To 2012 3. What is the facility type? C Rural Two-Lane, Two-Way Roads (* Rural Multilane Highways C Urban and Suburban Arterials
 Ø District 2 to District 9 What is the study period of the analysis? (max 5 years 2009) To 2009 To 2012 3. What is the facility type? Ø Rural Two-Lane, Two-Way Roads Ø Rural Multilane Highways Ø Urban and Suburban Arterials
2. What is the study period of the analysis? (max 5 years From 2009 To 2012 3. What is the facility type? C Rural Two-Lane, Two-Way Roads C Rural Multilane Highways C Urban and Suburban Arterials
From 2009 To 2012 3. What is the facility type? C Rural Two-Lane, Two-Way Roads C Rural Multilane Highways C Urban and Suburban Arterials
To 2012 3. What is the facility type? C Rural Two-Lane, Two-Way Roads C Rural Multilane Highways C Urban and Suburban Arterials
3. What is the facility type? C Rural Two-Lane, Two-Way Roads Rural Multilane Highways Urban and Suburban Arterials
Rural Two-Lane, Two-Way Roads Rural Multilane Highways Urban and Suburban Arterials
Rural Multilane Highways Urban and Suburban Arterials
C Urban and Suburban Arterials

STEP 2: A new window opens and shows the main menu interface. The main menu is comprised of two main tabs: **Input Data** and **Output Data**. The Input Data tab opens by default when starting the tool. The output tab contains a series of utilities including print preview, export, among others. Details about the output tab utilities are provided in Chapter 4.

R	ural Multilane Highways	in the gards of							
	Illinois Department of Transportation								
1		Load from Table							
		Load Input Data from Table							
	Step 1	Step 2	Step 3						
	New Project	Project Information	Divided Segment Input						
	Step 4	Step 5	Step 6						
	Undivided Segment Input	Intersection Input	Set up Spreadsheet						
	AASHID		Exit HSM Tool						

The Input Data tab has a total of seven buttons, which are used to run the analysis.

This new version of the tool includes two methods to run the analysis. The first one is using the button **Load Input Data from Table**, and the second one is following Steps 1 through 6. This example will be conducted using the six steps.

STEP 3: Sta	art by pressing	the New P	roject button	to display t	the Analysis I	nput form.
-------------	-----------------	-----------	---------------	--------------	----------------	------------

Multilane Rural Roads Analysis Input
Analysis Input :
Total Number of Divided Segments : 21
Total Number of Undivided Segments :
Total Number of Intersections :
Study Period : From 2009 to 2012
Multiyear Analysis
Apply Linear Traffic Growth Factor (%)
Enter AADT for Each Year
Analysis Method
Estimate Predicted Number of Crashes:
Input Data Output Data Estimate Expected Number of Crashes:
Load from Table
Load Input Data from Table
Step 1 Step 2 Step 3
New Project Project Divided Segment Information
Step 4 Step 5 Step 6
Undivided Segment Input Intersection Input Spreadsheet
AABHID Exit HSM Tool

STEP 4: Input the information requested in the fields. The **Total Number of Divided Segments**, the **Total Number of Undivided Segments**, and the **Total Number of Intersections** should be a number between 0 and 50. The **Study Period** will be pre-populated. This is the period for which crash data are available (for example, 2008 to 2012). The maximum study period length is 5 years. In this example, calibration factors, and crash default distribution tables for only 2009-2011 will be used.

Multiyear analyses can now be conducted using either a growth factor or entering AADT for each analysis year. Multiyear analysis options will be enabled only when the difference between study period years is greater than 1. If **Apply Linear Traffic Growth Factor (%)** is selected, enter the respective value in percentage. If AADT information for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text.

Analysis Method: If observed crash data are not available, select **Estimate Predicted Number of Crashes** by clicking on the circle next to the text. If observed crash data are available, select **Estimate Expected Number of Crashes** by clicking on the circle next to the text.

The expected crash frequency is obtained by applying the EB Method. This method combines the predicted average crash frequency with the observed crash data to provide a more reliable estimate. Selecting the **Estimate Expected Number of Crashes** will enable the Analysis Report frame. There are two methods to apply the EB adjustment using observed crash data. The **Observed Crash Data by Site Available** is used when available crash data are disaggregated by site (segments and/or intersections) and the **Observed Crash Data for the Project Available** is used when observed crash data are only available at aggregated/project level across the all the sites. Refer to the HSM Section A.2.4 and A.2.5 (Pages A-19 and A-20) for additional details on the different EB methods.

This analysis includes one divided segment, one undivided segment, and two intersections. The study period is from 2008 to 2012. The Multiyear Analysis will be conducted using AADT information for each year. The Estimate Expected Number of Crashes Using Observed Crash Data for the Project Available is the selected analysis method.

Multilane Rural Roads Analysis Input	×	
Analysis Input :		
Total Number of Divided Segments : 1	-÷	
Total Number of Undivided Segments :	÷	
Total Number of Intersections : 2	- ÷	
Study Period : From 2009 to 2012	2	
Multiyear Analysis		
Apply Linear Traffic Growth Factor (%)	0	
Enter AADT for Each Year	œ	
Analysis Method		
Estimate Predicted Number of Crashes:	0	
Estimate Expected Number of Crashes:	œ	
Analysis Report		
Observed Crash Data by Site Available:	C	
Observed Crash Data for the Project Available:	c	Microsoft Excel
Project Crashes		
Project Total Number of Crashes/Year: 25		Enter AADT for each year in Steps 3, Step 4 and Step 5.
Return to Mi	-in	

When complete click on the Return to Main button to return to the main input window.

STEP 5: On the main menu, select the button labeled Project Information.

Rural Multilane Highways	Multilane Rural Road Project Information
	General Project Information
Illinois Department of Transportation	Project Description : Roadway :
Input Data Output Data	Analyst : State :
Load from Table	Agency/Company: Jurisdiction :
from Table	Date (mm/dd/yyyy) : Study Period :
Step 1 Step 2 Step 3 New Project Divided Segment	Divided Segment Project Information
Information Input	Roadway Section : Major Road :
Step 4 Step 5 Step 6	Undivided Segment Project Information
Undivided Segment Input Intersection Input Spreadsheet	Roadway Section :
AASHID Exit HSM Tool	Return to Main

STEP 6: Complete the information requested in the General Project Information screen. For Divided and Undivided segment project information – Roadway Section, enter <u>either</u> a reference milepost or Key Route or Marked Route. Key Route refers to IRIS terminology and is a universal identifier for any segment. Marked Route refers to the Division of Traffic Safety route inventory. The key route information is not necessary for intersections, but all information provided will assist in tracking projects. For Intersection Project Information, enter a description for **Major Road** and **Minor Road** (for example, Golf Road and Milwaukee Ave., respectively). When all fields have been completed, click on **Return to Main**.

ultilane Rural Road Project Information		— X
General Project Information		
Project Description : Skokie Ave Analysis	Roadway :	Skokie Ave
Analyst : CC	State :	IL
Agency/Company: IDOT	Jurisdiction :	District 2
Date (mm/dd/yyyy) : 09/04/2013	Study Period :	2009 to 2012
Divided Segment Project Information	Intersection Proje	ct Information
Roadway Section : MP 12.5	Major Road :	Skokie Ave
Undivided Segment Project Information		Lawrence Stl
Roadway Section : MP 13.2	Minor Road :	Contraction of
		Return to Main

The main menu will re-open.

STEP 7: Select the button labeled Divided Segment Input.

Rural Mu	ıltilane Highways	cial free specific	X			
(The second seco	Illinois Deput Data Out	epartment o tput Data	of Transportation			
		Load from Table				
		Load Input Data from Table				
	Step 1	Step 2	Step 3			
	New Project	Project Information	Divided Segment Input			
	Step 4	Step 5	Step 6			
	Undivided Segment Input	Intersection Input	Set up Spreadsheet			
Exit HSM Tool						

The main interface closes, and two new tabs appear. Segment and intersection data are entered in these two tabs. The naming convention varies between different modules. **MLR** is for multilane rural roads, **TLR** is for the two-lane rural roads, and **UrbArt** is for Urban and Suburban Arterials. For this example the **MLR_4.1_Div_Seg_Input**, **MLR_4.2_Und_Seg_Input**, and **MLR_6.1_Int_Input** tabs are used for data entry. The tabs are sequentially numbered and are displayed based on the type of analysis selected.

MLR_4.1_Div_Seg_Input / MLR_4.2_Und_Seg_Input / MLR_4_Seg Tables / MLR_5_Rural MultiLn Int 1 / MLR_6.1_Int_Input /

STEP 8: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same

among all facilities, the user can copy and paste, or drag values among the different facility types. Table 3 provides details of the different variables needed to run the predictive method for segments.

TABLE 3	
Rural Multi-Lane Highways – Divided S	egments Data Input
Variable Name	Data Description/Units
Segment name	Name of the roadway segment. Up to 50 segments
Length of Segment	Miles
AADT	AADT for roadway segment
Lane width	Feet
Shoulder width	Feet
Shoulder Type–Right Shoulder for	Poved gravel composite or turf
divided	
Median Width	Feet
Segment lighting	Present or not present
Auto speed enforcement	Present or not present
Calibration factor	Derived from calibration process
	Fatal and injury crashes recorded for the segment; this value
KABC	is only applicable for Observed Crash Data by Site Available
	analysis method
	Property damage only crashes recorded for the segment; this
PDO	value is only applicable for Observed Crash Data by Site
	Available analysis method

The user may select from two buttons:

- Return to Main is used to go to the main menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.

Project Description		Skokie Ave A	Anlysis	
Analyst	CC			
Agency or Company		IDOT		
State		IL		
Date Performed		9/4/2013		
Jurisdiction		District 2		
Study Period		2009 to 2012		
Roadway		Skokie Ave		
Segment Name		Select S	egment	Segment 1
Length of Segment, L (mi)				0.7
Lane Width (ft)		12		12
Shoulder Width (ft)		6		6
Shoulder Type - Right Shoulder for Divided Segment		Pav	ed	Paved
Median Width (ft)				20
Segment Lighting (present/not present)		Not Pre	esent	Not Present
Auto Speed Enforcement (present/not present)		Not Pre	esent	Not Present
MULTIYEAR ANALYSIS	Go to	AADT Calcu	lation Tab	
Segment Name				Segment 1
AADT 2009				6.000
AADT 2010				6 200
AADT 2011				6,400
AADT 2012				6,600
				-,
	Print In	put Info	Retur	n to Main

When all fields have been completed, click on **Return to Main**.

STEP 9: Select the button labeled **Undivided Segment Input**.

Rural Mu	ultilane Highways			×			
Illinois Department of Transportation Input Data Output Data							
		Load from Table					
×		Load Input Data from Table					
	Step 1	Step 2	Step 3				
	New Project	Project Information	Divided Segment Input				
	Step 4	Step 5	Step 6				
	Undivided Segment Input	Intersection Input	Set up Spreadsheet				
Exit HSM Tool							

STEP 10: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 4 provides details of the different variables needed to run the predictive method for intersections.

TABLE 4

Rural Multilane Highways – Undivided Segments Data Input

Variable Name	Data Description
Segment name	Name of the roadway segment. Up to 50 segments
Length of Segment	Miles
AADT	AADT for roadway segment
Lane width	Feet
Shoulder width	Feet
Shoulder Type–Right Shoulder for divided	Paved, gravel, composite or turf
Side Slopes	1:2 or Steeper to 1:7 or Flatter
Segment lighting	Present or not present
Auto speed enforcement	Present or not present
Calibration factor	Derived from calibration process
KABC	Fatal and injury crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available analysis method
PDO	Property damage only crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available analysis method

Two buttons are at the bottom of the page:

- **Return to Main** is used to go to the Main Menu.
- Print Input Info is used to set the segment data input tab for printing using the Page Break View.

Project Description		Skokie Ave A	Anlysis	
Analyst		CC		
Agency or Company		IDOT		
State		IL		
Date Performed		9/4/2013		
Jurisdiction		District 2		
Study Period		2009 to 2012		
Roadway		Skokie Ave		
Segment Name		Select S	eament	Segment 1
Length of Segment, L (mi)			<u> </u>	1.2
Lane width (ft)		12	2	12
Shoulder width (ft)		6		2
Shoulder type		Pav	ed	Paved
Side Slopes		1:	5	1:3
Segment lighting (present/not present)		Not Pre	esent	Not Present
Auto speed enforcement (present/not present)		Not Pre	esent	Not Present
MULTIYEAR ANALYSIS	Go to	AADT Calcu	lation Tab	
Segment Name				Segment 1
AADT 2009				6,000
AADT 2010				6,200
AADT 2011				6,400
AADT 2012				7,000
			,	
	Print In	put Info	Return	to Main

When all fields have been completed, click on **Return to Main**.

STEP 11: Select the button labeled Intersection Input.

Rural M	ultilane Highways			×		
जि In	put Data Ou	epartment o tput Data	f Transportatio	'n		
		Load from Table				
		Load Input Data from Table				
	Step 1	Step 2	Step 3			
	New Project	Project Information	Divided Segment Input			
	Step 4	Step 5	Step 6			
	Undivided Segment Input	Intersection Input	Set up Spreadsheet			
AASHID Exit HSM Tool						

STEP 12: Enter the information requested in the fields of the **Rural Multilane Intersection Input** window for each intersection included in the analysis. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 5 provides details of the different variables needed to run the predictive method for intersections.

Variable Name	Data Description
Intersection name	Name of the intersection. Up to 50 intersections
Intersection type	Three-leg stop control (3ST), four-leg stop control (4ST), four-leg signalized intersection (4SG).
AADT major	AADT for major roadway segment
AADT minor	AADT for minor roadway segment
Intersection skew angle	Degrees
Number of non-STOP-Controlled approaches with LT lane	0, 1, or 2
Number of non-STOP-Controlled approaches with RT lane	0, 1, 2, 3 or 4
Intersection lighting	Present or not present
Calibration Factor, Cr	Derived from calibration process
KABC	Fatal and injury crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available analysis method
PDO	Property damage only crashes recorded for the segment; this value is only applicable for Observed Crash Data by Site Available Analysis method

TABLE 5 Rural Multilane Highways – Intersections Data Input

Two buttons are at the bottom of the page:

- Return to Main is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.

Project Description					Skokie Ave Anlysis		
Analyst					CC		
Agency or Company					IDOT		
State					IL		
Date Performed					9/4/2013		
Jurisdiction					District 2		
Study Period					2009 to 2012		
Roadway					Skokie Ave		
Intersection Name					Select Intersection	Intersection 1	Intersection 2
Intersection type (3ST, 4ST, 4SG)						4ST	3ST
Intersection skew angle (degrees)) 0
Number of signalized or uncontrolled approaches w	ith a left-tu	um lane (0,	1, 2, 3, 4)			0) 1
Number of signalized or uncontrolled approaches w	ith a right-	turn lane (C	0, 1, 2, 3, 4			0) 0
Intersection lighting (present/not present)					Not Present	Present	Not Present
MUI TIYFAR ANAI YSIS	;	Go to AA	DT Calculat	ion Tab			
	·					Internation 4	Internetion 2
						Intersection 1	E 000
AADT 2003						6,00	6 200
AADT 2010						6,20	6,200
AADT 2012						7.00	7 000
AADT 2012						7,00	7,000
Minor Intersection						Interception 1	Intersection 2
						1.50	2 500
AADT 2003						1,30	2,300
AADT 2010						2.00	2,700
AADT 2012						2,00	1 3,000
						2,10	3,000
	Drint Inr	ut Info		Retur	n to Main		
		Jucinito		netui	n to mant		

When all fields have been completed, click on Return to Main.

STEP 13: Select the button labeled **Set up Spreadsheet**.

Rural Mu	Itilane Highways			×
କ Int	Illinois D out Data Our	epartment o tput Data	of Transportation	on
		Load from Table		
		Load Input Data from Table		
	Step 1	Step 2	Step 3	
	New Project	Project Information	Divided Segment Input	
2	Step 4	Step 5	Step 6	
	Undivided Segment Input	Intersection Input	Set up Spreadsheet	
AAS	HD		Exit HSM Tool	

Based on the selected options, when creating a new project the user will see a message similar to the image shown below with next step instructions.

Microsoft Excel
Based on the selected options, the tool has set up calculation and summary sheets. Calculation tabs can be seen by clicking the"Show Calculations"Button in the Main Menu - Output Tab.
For this analysis, results can be found under the MLR_9_RuralMultiLn_Proj_EB_Tot tab Close the Main Menu user form using the"x"located in the top right corner, and proceed with reviewing the input data.
If you would like to go back to the Main menu, click on any of the "Return to Main"buttons located under the instructions and summary tabs
ОК

Click **OK**, and then close the Rural Multilane Highways main menu user form by clicking on the **X** button on the top right of the box.

IDOT HSM Crash Prediction Tool

Rural N	Aultilane Highways		X
	Illinois De put Data Out	epartment o put Data	f Transportation
		Load from Table	
N N		Load Input Data from Table	
	Step 1	Step 2	Step 3
	New Project	Project Information	Divided Segment Input
2	Step 4	Step 5	Step 6
	Undivided Segment Input	Intersection Input	Set up Spreadsheet
AA	ана ССС	NW	Exit HSM Tool

The IDOT HSM tool can be used for analyzing single facilities, as well as for corridors with multiple segments and intersections and multi-year crash data. The **Set up Spreadsheet** procedure will create a customized summary sheet depending on the number of facilities, study period, and analysis method selected.

STEP 14: For this example the final results will be shown in tab **MLR_102_ProjEB_ExSum**. The executive summary contains predicted and expected average crash frequency for Total, Fatal and Injury (KABC), and Property Damage Only (PDO) crashes. In addition, the HSM Potential for Safety Improvement is included. The executive summary is shown below:



The user can navigate through the other tabs to make changes if needed. The predictive method calculations for each facility type are available and can be displayed using the utilities in the **Output Tab** in the main menu. Chapter 4 of this guide provides additional information regarding the different utilities available for all three modules.

Tab MLR_9_RuralMultiLn_Proj_EB_Tot contains the predicted, expected, and observed crashes for all the facilities included in the analysis.

CH2MHILL.		Vortche	st 54 Prodie	ated and Obc	Multilane Ru	ral Roads Summ	ary Sheet Site Tupe IIci	ng the Projec	t-l aual EP	Mathod			
Analust	CC	TOIKSIE	et 3A 1 Teak	ited and Obs	erved Crasile.	s by Severicy and	Boadwau	Skokie Ave	C-Level LD	Hechoa			
Agencii or Compani	IDOT						Jurisdiction	District 2					
Date Performed	9/4/2013						Studu Period	2009 to 2012					
Project Description	Skokie Ave An	usis					otaagr choa	LOOD TO LOIL					
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
		Predicted	average crasi	frequency	Observed								
01			(crashes/year)	crashes,	Overdispersion	N	N_1	¥.	N.	¥1	N.,	N,/
Site tj	lbe	Nuccess	Number	Number	Natarrard	Parameter, k	Equation A-8	Equation A-9	Equation	Equation	Equation	Equation	Equation
		(TOTAL)	(ED	(PDO)	(crashes/year)		[6] [2]	sqrt((6)*(2))	A-10	A-11	A-12	A-13	A-14
		(121112)		(, = =)	ROADVA	Y SEGMENTS DI	VIDED	1 1 1 1 1 1 1					
Segment 1 (Divided)		1.107	0.602	0.504			0.372	0.579					
Year1 2009		1.051	0.575	0.476		0.304	0.335	0.565					
Year2 2010		1.088	0.593	0.495		0.304	0.359	0.575					
Year3 2011		1.125	0.612	0.513		0.304	0.384	0.584					
Year4 2012		1.162	0.630	0.532		0.304	0.410	0.594					
					ROADVAY	SEGMENTS UND	DIVIDED						
Segment 1 (Undivide	d)	2.869	1.783	1.086			1.291	0.669					
Year1 2009		2.658	1.661	0.997		0.156	1.103	0.644					
Year2 2010		2.763	1.721	1.041		0.156	1.191	0.657					
Year3 2011		2.868	1.782	1.085		0.156	1.284	0.669					
Year4 2012		3,186	1.966	1.221		0.156	1.585	0.705					
					IN	TERSECTIONS							
Intersection 1		1.187	0.641	0.546			0.703	0.765					
Year1 2009		1.025	0.543	0.482		0.494	0.519	0.712					
Year2 2010		1.130	0.607	0.523		0.494	0.631	0.747					
Year3 2011		1.232	0.669	0.563		0.494	0.750	0.780					
Year4 2012		1.359	0.744	0.615		0.494	0.912	0.819					
Intersection 2		0.187	0.074	0.113			0.016	0.293					
Year1 2009		0.169	0.067	0.101		0.460	0.013	0.279					
Year2 2010		0.179	0.071	0.107		0.460	0.015	0.287					
Year3 2011		0.189	0.075	0.114		0.460	0.016	0.295					
Year4 2012	(0.212	0.084	0.128		0.460	0.021	0.312					
COMBINED (sum o	e columnj	0.348	3.100	2.243	20		2.382	2.306	0.632	11.404	0.633	11.268	11.336
		Vorkshee	t 4B Projec	t-Level EB N	lethod Summa	ar u Results							
						,							
-	(1)			(2)			[3]						
Crash severity le	evel			Nurrdiated			Neurofed						
Total			(2)	from Worksh	eet 5A	(13)	from Workshee	15A					
			(1)(0)	5.3		(10)com	11.3						
Fatal and injury (FI)			(2)		eet 54	m	····						
			[3]60	21	eet vin	[0]10	CC	AL					
Propertu damade or	du (PDO)		(0)	J.I George Marshah		(2)	•(2) +(2)						
 copercy damage of 	-9(, DO)		[4]co	nom worksh	ieer o.A	(3)TOT	AL (C)PDOF(C) TO	TAL					
			1	2.2		1	4.8						

The three buttons on the top right side of the summaries can be used to return to the main menu, or hide and unhide unused rows.



Tabs MLR_4.1_Div_Seg_Input, MLR_4.2_Und_Seg_Input, and MLR_6.1_Int_Input contain the input data used in this analysis.

Note: Worksheets **MLR_4_Seg Tables** and **MLR_6_Int Tables** contain the HSM predictive method supporting tables. IDOT has developed state-specific values for all these different distributions and there is no need to use the HSM default values.

However, the IDOT HSM tool is flexible enough to allow modifications to such tables. Input data required from the user but restricted to **Yes** and **No** options are provided in the pull-down boxes (Blue cells). Orange cells contain the locally-derived data as shown in the graphic below.

Tables Affiliated with Crash St	tatistics:								
Table 11	-4: Distribu	tion of Crashes	s by Collision	Type and Crash	Severity Leve	el for Undivide	Roadway Sec	ments	
Collision type			Pr	oportion of cras	nes by collisi	on type and cr	ash severity l	evel	
			HSM-Prov	ided Values			Illinois-Spe	ecific Values	
Illinois-Specific Values?	Yes	Total	Fatal and	Fatal and injury	PDO	Total	Fatal and	Fatal and injury	PDO
			injury	•			injury	•	
Head-on		0.009	0.029	0.043	0.001	0.009	0.029	0.043	0.001
Sideswipe		0.098	0.048	0.044	0.120	0.098	0.048	0.044	0.120
Rear-end		0.246	0.305	0.217	0.220	0.246	0.305	0.217	0.220
Angle		0.356	0.352	0.348	0.358	0.356	0.352	0.348	0.358
Single		0.238	0.238	0.304	0.237	0.238	0.238	0.304	0.237
Other		0.053	0.028	0.044	0.064	0.053	0.028	0.044	0.064
SV run-off-rd, Head-on, Sideswip	e	0.270				0.270			
NOTE: * Using the KABCO scale, these i	include only KA	AB crashes. Crashes	s with severity level	C (possible injury) are	not included.				
Table 1	1-6: Distrib	ution of Crashe	es by Collision	Type and Crash	Severity Lev	vel for Divided	Roadway Seqr	nents	
Collision type			Pr	oportion of cras	nes by collisi	on type and cr	ash severity l	evel	
			HSM-Prov	ided Values			Illinois-Spe	cific Values	
Illinois-Specific Values?	Yes	Total	Fatal and	Fatal and injury	PDO	Total	Fatal and	Fatal and injury	PDO
			injury	a			injury	a	
Head-on		0.006	0.013	0.018	0.002	0.005	0.016	0.019	0.002
Sideswipe		0.043	0.027	0.022	0.053	0.053	0.069	0.063	0.049
Rear-end		0.116	0.163	0.114	0.088	0.079	0.186	0.190	0.056
Angle		0.043	0.048	0.045	0.041	0.004	0.000	0.000	0.004
Single		0.768	0.727	0.778	0.792	0.834	0.681	0.677	0.866
Other		0.024	0.022	0.023	0.024	0.027	0.048	0.051	0.022
SV run off rd Head on Sideewin		0.500							
NOTE: "Using the KABCO scale, these i	include only KA	AB crashes. Crashes	with severity level	C (possible injury) are	not included.				
	т	able 11-15: Nig	ht-time Crash	Proportions for	Unlighted Ro:	adway Segme	nts		
Roadway Type			HSM-Prov	ided Values			Illinois-Spe	ecific Values	
		Proportion (of total night-			Proportion	of total night-		
Illinois-Specific Values?	Yes	time crashes by severity		Proportion of crashes that		time crashes by severity		Proportion of crashes that	
		Fatal and	PDO, Darr	n	-	Fatal and	PDO, Darr	n.	-
		injury p	· · · · · · · · · · · · · · · · · · ·	Phr		iniury p	i e e i e par	Ph	
40		0.361	0.639	0.25	5	0.361	0.639	0.25	5
				0.20	-			0.20	
	т	able 11-19: Nig	ht-time Crash	Proportions for	Unlighted Roa	adway Segme	nts		
Roadway Type		1	HSM-Prov	ided Values	-		Illinois-Spe	ecific Values	
		Proportion of	of total night-			Proportion of	of total night-		
Illinois-Specific Values?	Yes	time crashe	s by severity	Proportion of c	rashes that	time crashe	s by severity	Proportion of	rashes that
		le	vel	occur at	niaht	le	vel	occur at	night
		Eatal and	PDO n			Eatal and	PDO n		
		iniuna	PDO, ppn	Pnr		iniunana	PDO, ppn	Pn	
40		0.323	0.677	0.42	6	0.121	0.879	0.70	13
U F		0.525	0.011	0.42	•	0.121	0.013	0.70	

STEP 15: To print the summary, export data, or make changes, click on the **Return to Main** button on the top right side of the summary tabs. This will prompt the main menu. Click on the **Output Data** tab.

Rural Mi	Illinois Deput Data Out	epartment o put Data	f Transportation	
	Show Detailed Analysis	Show Calculations	Print Preview	
	Export Data	Edit/Change Analysis	Help	
AAS		N//	Exit HSM Tool	

Show Detailed Analysis: Displays the background summary calculations.

Show Calculations: Displays the predictive method calculations (tabs) for each facility included in the analysis. **Note:** Since this example includes the 2009-2011 calibration factors, the background calculations will be unhidden after clicking this button.

Print Preview: Prepares the summary sheet for printing.

Export Data: Creates a copy of the spreadsheet.

Edit/Change Analysis: Allows the user to make changes, including adding facilities, changing values, and re-running the set-up process.

Help: Provides a hyperlink to the IDOT HSM tool user's manual posted on IDOT website.

Details about these utilities are provided in Chapter 4.

3.3 Urban and Suburban Arterials

3.3.1 Introduction

Chapter 12 of the HSM provides a methodology for estimating the predicted average crash frequency, crash severity, and collision types for urban and suburban facilities. This chapter is applicable to arterials without full access control (other than freeway), with two- or four-lane undivided facilities, four-lane divided, and three- and five-lane roads with center two-way left-turn lanes in urban and suburban areas. Details about the applicability of this module can be found in the HSM Section 12.3.

This example illustrates how to apply the Urban and Suburban Arterials predictive method using the IDOT HSM tool.

STEP 1: The screen capture below shows the opening page of the IDOT HSM tool. In the Getting Started window, enter the following information: **Project Location**: District 1, **Study period**: 2005-2008, and **Facility type**: Urban and Suburban Arterial.

Getting Started
1. Please select the District where this project is located.
District 1
 District 2 to District 9
2. What is the study period of the analysis? (max 5 years)
From 2005
To 2008
3. What is the facility type?
C Rural Two-Lane, Two-Way Roads
C Rural Multilane Highways
 Urban and Suburban Arterials
Start Analysis

STEP 2: A new window opens and shows the main menu interface. The main menu is comprised of two main tabs: **Input Data** and **Output Data**. The Input Data tab opens by default when starting the tool. The Output Data tab contains a series of utilities including print preview, export, among others. Details about the output tab utilities are provided in Chapter 4.

This new version of the tool includes two methods to run the analysis. The first one is using the button **Load Input Data from Table**, and the second method is following Steps 1 through 5. This example will be conducted using the five steps.

Printed

STEP 3: Select the button labeled New Pr	ject. The Analysis	Input user form will appear
--	---------------------------	-----------------------------

	Urban and Suburban Arterials Analysis Input	
	Analysis Input : Total Number of Segments : 2	
	Total Number of Intersections :	
	Study Period : From 2005 to 2008	
	Multiyear Analysis	
	Apply Linear Traffic Growth Factor (%)	
lakes and Calculate Astroids	Enter AADT for Each Year	
Jrban and Suburban Arterials	- Analysis Method	
() Illinois Department of Transpo	C Estimate Predicted Number of Crashes:	
Input Data Output Data	Estimate Expected Number of Crashes:	
Load from Step 1 Step 2	2	
Load Input Data from Table New Project Information	ct tion	
Step 3 Step 4 Step 5	5	
Segment Input Intersection Input Spreadsh	p heet	
	Return to Main	

STEP 4: Input the information requested in the fields. The **Total Number of Segments** and the **Total Number of Intersections** should be a number between 0 and 50. The **Study Period** will be pre-populated. These fields contain the period for which crash data are available.

Multiyear analyses can now be conducted using either a growth factor or entering AADT for each analysis year. Multiyear analysis options will be enabled only when the difference between study period years is greater than 1. If **Apply Linear Traffic Growth Factor (%)** is selected, enter the respective value in percentage. If AADT for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text. Details on how to apply the Linear Traffic Growth Factor can be found in Section 2.2. After clicking the Enter AADT for Each Year option, a window will open indicating what steps are needed to enter the AADT data (see figure below).

Analysis Method: If observed crash data are not available, select **Estimate Predicted Number of Crashes** by clicking on the circle next to the text. If observed crash data are available, select **Estimate Expected Number of Crashes** by clicking on the circle next to the text.

The expected crash frequency is obtained by applying the EB Method. This method combines the predicted average crash frequency with the observed crash data to provide a more reliable estimate. Selecting the **Estimate Expected Number of Crashes** will enable the Analysis Report frame. There are two methods to apply the EB adjustment using observed crash data. The **Observed Crash Data by Site Available** is used when available crash data are disaggregated by site (segments and/or intersections), and the **Observed Crash Data for the Project Available** is used when observed crash data are only available at aggregated/project level across the all the sites. Refer to the HSM Section A.2.4 and A.2.5 (Pages A-19 and A-20) for additional details on the different EB methods.

This analysis includes two segments and three intersections. The study period is from 2008 to 2011. The multiyear analysis will be conducted using AADT for each year. **Estimate Expected Number of Crashes** using **Observed Crash Data by Site** is the selected analysis method.

1	Urban and Suburban Arterials Analysis Input	
	Analysis Input : Total Number of Segments :	
	Total Number of Intersections :	
	Study Period : From 2005 to 2008	
	Multiyear Analysis	
	Apply Linear Traffic Growth Factor (%)	
	Enter AADT for Each Year 🙃	
	Analysis Method	
	Estimate Predicted Number of Crashes: C	
	Estimate Expected Number of Crashes:	
	Analysis Report	
	Observed Crash Data by Site Available:	
	Observed Crash Data for the Project Available:	
Enter AADT for each year in Steps 3 and Step 4.		
ОК	Return to Main	

When complete click on the **Return to Main** button to return to the main input window. **STEP 5:** On the main menu, select the button labeled **Project Information**.

Urban and Suburban Arterials	Urban and Suburban Arterial Project Information
Mulacia Department of Transportation	General Project Information
Inimoles Department of mansportation	Project Description : Roadway :
Input Data Output Data	Analyst : State :
Load from Step 1 Step 2	Agency/Company: Jurisdiction :
Load Input Data from Table New Project Information	Date (mm/dd/yyyy) : Study Period :
Stop 2 Stop 4 Stop 5	Segment Project Information
Segment Input Intersection Input Set up	Roadway Section : Major Road :
Spreadsheet	Minor Road :
AASHO	Return to Main

STEP 6 Complete the information requested in the General Project Information input window. For Segments Project Information, enter <u>either</u> a reference milepost or Key Route or Marked Route. Key Route refers to IRIS terminology and is a universal identifier for any segment. Marked Route refers to the Division of Traffic Safety route inventory. The key route information is not necessary for intersections, but all information provided will assist in tracking projects. For Intersection Project Information, enter a description for **Major Road** and **Minor Road** (for example, Golf Road and Milwaukee Ave., respectively). When all fields have been completed, click on **Return to Main**.

Urban and Suburban Arterial Project Information		X
General Project Information		
Project Description : Jrban Arterial Safety Project	Roadway :	Golf Rd
Analyst : CC	State :	IL
Agency/Company: IDOT	Jurisdiction :	District 1
Date (mm/dd/yyyy) : 09/04/2013	Study Period :	2005 to 2008
Segment Project Information	Intersection Proje	ct Information
Roadway Section : MP 2.8	Major Road :	Golf Rd
	Minor Road :	Milwaukee Ave
		Return to Main

STEP 7: Select the button labeled **Segment Input**.

Urban and	d Suburban Arterials	epartment o	f Transportation
	Load from Load Input Data from Table	Step 1 New Project	Step 2 Project Information
X Y	Step 3	Step 4 Intersection Input	Step 5 Set up Spreadsheet
AASI			Exit HSM Tool

	DTE: Depending on the analysis input data entered, there are instances when an ditional user form appears asking about the data entry method.
	Input Segment Data
	Enter Data Manually Read Data from Table
	ter Data Manually: Data entry is performed one facility at a time using a user
	m.
	ead Data from Table: Data entry is performed for all facilities using a table orksheet)
1	

The main interface closes, and two new tabs appear. Segment and intersection data are entered in these two tabs. The naming convention varies between different modules. **TLR** is for the Two-Lane Rural roads, **MLR** is for Multilane Rural roads, and **UrbArt** abbreviation is for Urban and Suburban Arterials. For this example, the **UrbArt_3_Seg_Input** and **UrbArt_5_Int_Input** tabs are used for data entry. The tabs are sequentially numbered and are displayed based on the type of analysis selected.

1_Start UrbArt_3_Seg_Input UrbArt_5_Int_Input

STEP 8: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same among all facilities, the user can copy and paste, or drag values among the different facility types. Table 6 provides details of the different variables needed to run the predictive method for segments.

Project Description	Urban Arterial Sa	fety Project	
Analust	CC		
Agency or Company	IDOT		
State	IL		
Date Performed	9/4/2013		
Jurisdiction	District 1		
Study Period	2005 to 2008		
Boadwaii	Golf Bd		
Thousing	CIONTIG		
Segment Name	Select Segment	Segment 1	Segment 2
Roadway type (2U, 3T, 4U, 4D, 5T)		4U	4D
Length of segment, L (mi)		0.75	0.5
Type of on-street parking (none/parallel/angle)	None	Parallel (Comm/Ind)	None
Proportion of curb length with on-street parking (0.5 Lpk/L)		0.75	0
Median width (ft) - for divided only	15	Not Present	15
Lighting (present / not present)	Not Present	Not Present	Not Present
Auto speed enforcement (present / not present)	Not Present	Not Present	Not Present
Maior commercial driveways (number)		1	0
Minor commercial drivewaus (number)		2	1
Major industrial / institutional drivewaus (number)		3	2
Minor industrial / institutional driveways (number)			3
Major residential drivewais (number)			Ť
Minor residential driveways (number)			
Other driveways (number)			
Speed Esterory		Rested Speed 20 mpk or Lower	Posted Speed 20 mpk or Lower
Boadcide fined object dencity (fined objects / mi)	0	Posted opeed of hiph of Lower	Posted opeed so riph of Lower
Officet to readgide fixed objects (9) If greater than 20 or Not Precent input 201	20	20	20
Multiple suchials a perdition on socials and KADC (alternational social resent, input soj			
Multiple vehicle condriveway crashes - NABC. (observed crashesheet)			
Multiple vehicle nondriveway crashes - PDU. (observed crashesryear)			0
[Viultiple venicle nondriveway crashes - KABLU. [Total crashesryear]		8	0
Single-vehicle crashes - KABC. (observed crashes/year)		2	1
Single-vehicle crashes - PUU. (observed crashes/year)		8	6
Single-vehicle crashes - KABCO. (Total crashes/year)		10	7
Multiple vehicle driveway crashes - KABC. (observed crashes/year)		2	2
Multiple vehicle driveway crashes - PDO. (observed crashes/year)		9	7
Multiple vehicle driveway crashes - KABCO (Total crashes/year)		11	9
MULTIVEAD ANALVELC Go to AADT Calculation	Tab		
WULTTEAK ANALTSIS			
Segment Name		Segment 1	Segment 2
AADT 2005		5.000	6.500
AADT 2006		6.000	7.000
AADT 2007		7.000	7.000
AADT 2008		8.000	8.000
		0,000	6,000
Print Input Info	Return to Main	1	
rint input into			
	1		

TABLE 6 Urban and Suburban Arterials – Segment Data Needs

Variable Name	Data Description
Segment name	Name of the roadway segment. Up to 50 segments
Roadway type	2U, 3T, 4U, 5T
Length of Segment	Miles
AADT	AADT for roadway segment
Type of on-street parking	None, parallel, or angle
Proportion of curb length with on-	Percent of on-street parking available. Includes both sides of
street parking	the road (percent)
Median width-for divided only	Not present, or select from scale 10 Feet to 100 Feet
Lighting	Present or not present
Auto speed enforcement	Present or not present

Variable Name	Data Description
Major commercial driveways	Number in segment
Minor commercial driveways	Number in segment
Major industrial/institutional	Number in segment
driveways	Number in segment
Minor industrial/institutional	Number in segment
driveways	
Major residential driveways	Number in segment
Minor residential driveways	Number in segment
Other driveways	Number of other driveways in segment
Speed Category	30mph or lower, or greater than 30mph
Roadside fixed object density	Fixed objects/miles
Offset to roadside fixed objects	Feet
Calibration factor	Derived from calibration process
	KABC and PDO crashes recorded for the segment; this
Multiple Vehicle Driveway Crashes	value is only available for Observed Crash Data by Site
	Available
Multiple Vehicle Non-driveway	KABC and PDO crashes recorded for the segment; this
Crashes	value is only available for Observed Crash Data by Site
Clashes	Available
	KABC and PDO crashes recorded for the segment; this
Single Vehicle Crashes	value is only available for Observed Crash Data by Site
	Available

TABLE 6 Urban and Suburban Arterials – Segment Data Needs

The user may select from three buttons:

- Return to Main is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- Crash by Year is an optional button only used for the Estimate Expected Number of Crashes using Observed Crash Data by Site Available analysis method. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet. By clicking this button, additional rows at the bottom of the page will be unhidden and crash data for each segment included in the analysis, by severity levels for each study period year, can be entered.

In addition, a new button (**Upload Number of Crashes by Year**), which is used to populate the crash data input in the main input table, appears.

Observed Crash Documentation Segment Name Multiple vehicle nondriveway crashes - KABC Crashes 2005 Multiple vehicle nondriveway crashes - KABC Crashes 2006	Segment 1
Segment Name Multiple vehicle nondriveway crashes - KABC Crashes 2005 Multiple vehicle nondriveway crashes - KABC Crashes 2006	Segment 1
Multiple vehicle nondriveway crashes - KABC Crashes 2005 Multiple vehicle nondriveway crashes - KABC Crashes 2006	
Multiple vehicle nondriveway crashes - KABC Crashes 2006	
Multiple vehicle nondriveway crashes - KABC Crashes 2007	
Multiple vehicle nondriveway crashes - KABC Crashes 2004	
Multiple vehicle nondriveway crashes - KABC Crashes 2008	
	0
Segment Name	Segment 1
Multiple vehicle nondriveway crashes - PDO Crashes 2005	
Multiple vehicle nondriveway crashes - PDO Crashes 2006	
Nultiple vehicle nondriveway crashes - PDO Crashes 2007	
Multiple vehicle nondriveway crashes - PDO Crashes 2004	
Nultiple vehicle nondriveway crashes - PDO Crashes 2008	
	0
3egment Name	Segment 1
Single-vehicle crashes - KABC Crashes 2005	
Single-vehicle crashes - KABC Crashes 2006	
Single-vehicle crashes - KABC Crashes 2007	
Single-venicle crashes - KABC Crashes 2004	
Single-venicle crasnes - KABC Crasnes 2008	
Pagmant Nama	Cogmont 1
Single vehicle crashes - PDO Crashes 2005	Segment i
Single-vehicle crashes - PDO Crashes 2005	
Single-vehicle crashes - PDO Crashes 2000	
Single-vehicle crashes - PDO Crashes 2004	
Single-vehicle crashes - PDO Crashes 2008	
	0
Segment Name	Segment 1
Multiple vehicle driveway crashes - KABC Crashes 2005	
Multiple vehicle driveway crashes - KABC Crashes 2006	
Multiple vehicle driveway crashes - KABC Crashes 2007	
Multiple vehicle driveway crashes - KABC Crashes 2004	
Multiple vehicle driveway crashes - KABC Crashes 2008	
	0
Segment Name	Segment 1
Multiple vehicle driveway crashes - PDO Crashes 2005	
Multiple vehicle driveway crashes - PDO Crashes 2006	
Multiple vehicle driveway crashes - PDO Crashes 2007	
Multiple vehicle driveway crashes - PDO Crashes 2004	
Nultiple vehicle driveway crashes - PDO Crashes 2008	
	0
Unload Number of Crashes By Year	

When all fields have been completed, click on Return to Main.

STEP 9: Select the button labeled **Intersection Input**.

np	out Data Ou	tput Data	
	Load from	Step 1	Step 2
	Load Input Data from Table	New Project	Project Information
	Step 3	Step 4	Step 5
	Segment Input	Intersection Input	Set up Spreadsheet

STEP 10: Enter data in the color-coded cells. Cells highlighted in yellow are hardcoded values. Cells highlighted in blue are dropdown menus with pre-set options. If particular data values are the same

among all facilities, the user can copy and paste, or drag values among the different facility types. Table 7 provides details of the different variables needed to run the predictive method for intersections.

TABLE 7 Urban and Suburban Arterial – Intersection Dat	a Needs
Variable Name	Data Description
Intersection name	Name of the roadway segment. Up to 20 segments
Intersection type	3ST, 4ST, 4SG
AADT major	AADT for major roadway segment
AADT minor	AADT for major roadway segment
Intersection lighting	Present or not present
Calibration factor	Derived from calibration process
Data for unsignalized intersections only	<u> </u>
Number of major-road approaches with left-	0.1 or 0
turn lanes	U, I, OF Z
Number of major-road approaches with right-	0.1 or 2
turn lanes	0, 1, 01 2
Data for signalized intersections only	
Number of approaches with left-turn lanes	0,1,2,3 or 4
Number of approaches with right-turn lanes	0,1,2,3 or 4
Number of approaches with left-turn signal	0123 or 1
passing	0,1,2,5 01 4
Type of left-turn signal phasing for Leg #1	Not applicable, permissive, protected,
	protected/permissive, or permissive/protected
Type of left-turn signal phasing for Leg #2	Not applicable, permissive, protected,
	protected/permissive, or permissive/protected
Type of left-turn signal phasing for Leg #3	Not applicable, permissive, protected,
	protected/permissive, or permissive/protected
Type of left-turn signal phasing for Leg #4	Not applicable, permissive, protected,
	protected/permissive, or permissive/protected
Number of approaches with right-turn-on-red	0123 or 4
prohibited	
Intersection red light cameras	Present or not present
Sum of all pedestrian crossing volumes-only	Sum of pedestrian volume
signalized intersection	
Maximum number of lanes crossed by a	Number of lanes
Number of bus stops within 300 meters	Number
(1,000 feet) of intersection	
Schools within 300 meters (1,000 feet) of	Number
Intersection	
within 200 meters (1,000 feet)	Number
	KABC and PDO crashes recorded for the intersection:
Multiple Vehicle Crashes	this value is only available for Observed Crash Data by
	Site Available
	KABC and PDO crashes recorded for the intersection:
Single Vehicle Crashes	this value is only available for Observed Crash Data by
	Site Available

The user may select from three buttons:

- Return to Main is used to go to the Main Menu.
- **Print Input Info** is used to set the segment data input tab for printing using the Page Break View.
- **Crash by Year** is an optional button only used for the Expected crash frequency using observed crash data by site. This utility is used only if the user wants to document the crashes by year by segment in the spreadsheet.

Project Description				Urban Arterial Safet	Project		
Analust				CC			
Agency of Company				IDOT			
State				IL			
Date Performed				9/4/2013			
Jurisdiction				District 1			
Study Period				2005 to 2008			
Roadway				Golf Rd			
Intersection Name				Select Intersection	Intersection 1	Intersection 2	Intersection 3
Intersection type (3ST, 3SG, 4ST, 4SG)					4ST	48G	3ST
Intersection lighting (present/not present)				Not Present	Not Present	Not Present	Not Present
1	Data for un	signalized into	ersections only:				
Number of major-road approaches with left-	turn lanes (0,1,2)			0	0		0
Number of major-road approaches with right	t-turn lanes (0,1,2)			0	0		0
	Data for	signalized into	ersections only:				
Number of approaches with left-turn lanes (0	0,1,2,3,4) [for 38G, us	e maximum val	lue of 3]	0		0	
Number of approaches with right-turn lanes	(0,1,2,3,4) [for 3SG, u	ise maximum v	alue of 3]	0		0	
Number of approaches with left-turn signal p	phasing [for 3SG, use	maximum valu	e of 3]			0	
Type of left-turn signal phasing for Leg #1						Not Applicable	
Type of left-turn signal phasing for Leg #2						Not Applicable	
Type of left-turn signal phasing for Leg #3						Not Applicable	
Type of left-turn signal phasing for Leg #4 (if applicable)					Protected	
Number of approaches with right-turn-on-re	d prohibited [for 38G	i, use maximur	n value of 3]	0		0	
Intersection red light cameras (present/not p	present)			Not Present		Not Present	
Sum of all pedestrian crossing volumes (Peo	dVol) Signalized inte	ersections onl	V.			200	
Maximum number of lanes crossed by a pede	estrian (nlanesx)					4	
Number of bus stops within 300 m (1,000 ft) of the intersection			0		0	
Schools within 300 m (1,000 ft) of the inters	ection (present/not pr	resent)		Not Present		Not Present	
Number of alcohol sales establishments with	in 300 m (1,000 ft) of	intersection				0	
Multiple vehicle crashes - KABC. (observed	crashes/year)				1	0	1
Multiple vehicle crashes - PDO. (observed cr	rashes/year)				16	8	6
Multiple vehicle crashes - KABCO (Total cra	(shes/year)				17	8	7
Single-vehicle crashes - KABC. (observed cr	ashes/year)				0	0	1
Single-vehicle crashes - PDO. (observed cras	shes/year)				3	5	6
Single-vehicle crashes - KABCO. (Total cras	hes/year)				3	5	7
MULTIVE AD ANALVOL	<u> </u>		Table Table				
IMULIIYEAR ANALYSI	5 _	GUIUAADIC	alculaton rao				
Major Intersection					Intersection 1	Intersection 2	Intersection 3
AADT 2005					5,000	6,500	6,200
AADT 2006					6,000	7,000	7,200
AADT 2007					7,000	7,500	7.650
AADT 2008					8,000	8,000	8.000
1							
Minor Intersection					Intersection 1	Intersection 2	Intersection 3
AADT 2005					1,200	2,000	1,800
AADT 2006					1,350	2,100	1,900
AADT 2007					1,500	2,200	2,000
AADT 2008					1,600	2,400	2,100
1							
			_				
	Print Input Info		Return to Ma	in			
	Trait input ano		Return to Ma				

After entering the data in the worksheet for both intersections, click **Return to Main**.

out Data O	utput Data	
Load from	Step 1	Step 2
Load Input Data from Table	New Project	Project Information
Step 3	Step 4	Step 5
Segment Input	Intersection Input	Set up Spreadsheet

STEP 11: The last step in the process is to run the **Set up Spreadsheet** procedure. After the process is done running, a new window appears providing instructions about next steps. It indicates what tab contains the summary sheet, and how to move forward with the analysis. Click **OK**, and the main menu interface appears.



Close the Urban and Suburban Arterials main menu by clicking on the X located in the top right corner of the user form.

Inp	out Data Ou	tput Data	
	Load from	Step 1	Step 2
2	Load Input Data from Table	New Project	Project Information
	Step 3	Step 4	Step 5
	Segment Input	Intersection Input	Set up Spreadsheet

STEP 12: After closing the main menu, the predictive method summary is available, along with other tabs containing back up calculations.

/ 1_Start / UrbArt_3_Seg Tables / UrbArt_3_Seg_Input / UrbArt_5_Int Tables / UrbArt_5_Int_Input / UrbArt_7_Site_EB_Total | UrbArt_91_SiteEB_ExSum /

For this example, the summary sheet is located in tab **UrbArt_91_SiteEB_ExSum**.

				Koadway	Golf Rd			
ar Company IDOT				Jurindiction	Dirtrict1			
tormod 97472)orcription Urban Artor	ns al Safety Project			Study Period	2005 to 2008			
T.	al Grachar Pa	Tear	Fatal and Ini	are Grachar	Par Taar (FI	lasts Damaa	only Grack	ar Par Taar (l
njøct panøstr H	d Expected average crark H	HSM Patential far Safett (HSM PSI)	Prodictod avorago crark H _{aten} u	Expected average crark H	HSM Patential far Safetr (HSM PSI)	Prodictod avorago crark H	Expected average crark H	HSM Patential far Safetr (HSM PSI)
	20.5	49.2	SEGME	NTS 7.0	6.2	15	12.5	12.0
amont2 : 0.6	8.3	7.6	0.2	2.1	2.0	0.5	6.1	5.7
and i dd	: 45.6	: 44.5	INTERSEC	TIONS	: 40	: 00	: 04	: 33
zoction2 4.4	9.5	5.1	1.4	3.0	1.6	3.0	6.5	3.5
soction3 : 0.8	: 8.2	7.4	: 0.3	2.9	2.6	0.5	5.3	4.8
BIMED 9.4 Fealana)	59.0	49.6	3.1	19.6	16.5	6.3	39.4	33.1
Crark Sav	ority Lovel		H , Predicte	disled 8 avorago	H	roled Average	HSH Pat	1 PSI ential far
			crark fr		ar ash fo			
				equency d		9 99998 67	Improv	vomont 4.6
rd Injury (FI)			9	equency (4 (1	5	9.0 9.6	4 1	9.6 6.5
nd Injury (FI) by Damage Only (PDO) Predi	cted and	Expecte Spe	d Crashe ecific EB	es by Ser Method	verity Us	sing the	Site-	**************************************
Hiniury (FI) y Damage Only (PDO) Predi HSM PSI	cted and	Expecte Sp	d Crashe	es by Sev Method	verity Us	sing the	Site-	**====t
nd Injury (FI) ty Domege Only (PDO) Predi HSM PSI	cted and	Expecte Spo	d Crashe	Method	verity Us	sing the	Site-	
Honjury (FI) y Damage Only (PDO) Predi HSM PSI	Fatal and Injury(Pi)	Expecte Spo 800 800 800	d Crashe	Method	verity U:	9.0 9.6 9.4 sing the	Site-	v.m.st 9.6 .5 3.1
Honjury (FI) (y Damage Only (PDO) Predi HSM PSI	rifect and rifect	Expecte Spi 800 800 800 800 800	d Crashe	Method	verity Us	9.0 9.6 9.4 sing the	Site-	vamaat 9.6 6.5 3.1
Halingury (FI) Hy Damage Only (PDO) Predi HSM PSI	(Fatal and Injury (Fi) Damage Only (PDO)	Expecte Spo 800 800 800 800 800 800	d Crashe	Method	verity Us	sing the	Site-	
Injury (FI) Damage Only (PDO) Predi HSM PSI	cted and Fatal and Injury(P) Damage Only (PDO)	Expecte Sp 500 500 500 500 500 500 500 500 500 50	d Crashe ecific EB	Method	verity Us	sing the	Site-	vamast vamast 4,6 5,5 3,1
Injury (FI) Damage Only (PDO) Predi HSM PSI	rated and Fratal and Injury (Pi) Damage Chily (PDO)	Expecte Sp 500 500 500 500 500 500 500 500 500 50	d Crashe ecific EB	Method	verity Us	sing the	Site-	
Injury (FI) Damage Only (PDO) Predi HSM PSI 13% 57% 13% 13% 13% 13% 13% 13% 13% 13	cted and riatal and Injury (Pi) Damper Only (PDO) Property Damper Only (PDO) Property Damper Antiper Antiperty Damper Anti	Expecte Spi 800 800 800 800 800 800 800 800 800 80	d Crashe ecific EB	Method	d atal and Injury (Fil 3.1 19.6	sing the	Property Demogra	

The user can navigate through the other tabs to make changes if needed. The predictive method calculations for each facility type are available and can be displayed using the utilities in the **Output Tab** in the main menu. Chapter 4 of this guide provides additional information regarding the different utilities available for all three modules.

Tab **UrbArt_7_Site_EB_Total** contains the predicted, expected, and observed crashes for all facilities included in the analysis.

Work	sheet 4A Pre	dicted Crashe	s by Severity an	d Site Type and	Observed Cras	hes Using the Sit	te-Specific EB M	ethod
Analyst	CC			Roadway	Golf Rd	_		
Agency or Company	DOT			Jurisdiction	District 1			
Date Performed	9/4/2013			Study Period	2005 to 2008			
Project Description	Urban Arterial S	afety Project						
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)
								Expected
		Predicted	average crash	frequency	Obsorved		Weighted	average crash
			(crashes/year)		Observeu	.	adjustment, w	frequency,
Collision type /	Site type				crasnes,	Overdispersion	• •	Nevrested
contenent ()per t					- N _{observed}	Parameter, k	Equation A.E.	Equation A 4
		N predicted	N predicted	N predicted	(crashes/year)		Equation A-5	Equation A-4
		(TOTAL)	(FI)	(PDO)			Appendix	Irom Part C
		(DWAY CECHE	TC		Appendix	Appendix
Multiple vohicle pend	rivoway		RUA	ADWAT SEGME	115			
Segment 1	incing	1 212	0.404	0.808	8	1.010	0 170	6.849
Voor1 200E		0.040	0.404	0.000	0	1.010	0.170	0.043
Tear 2005		0.049	0.290	0.559	0	1.010		
Year2 2006		1.082	0.304	0.719	8	1.010		
Year3 2007		1.329	0.441	0.888	8	1.010		
Year4 2008		1.587	0.520	1.067	8	1.010		
Segment 2		0.380	0.115	0.265	5	1.320	0.332	3.464
Year1 2005		0.335	0.102	0.233	5	1.320		
Year2 2006		0.371	0.112	0.259	5	1.320		
Year3 2007		0 371	0.112	0.259	5	1.320		
Year4 2008		0 445	0 133	0.311	5	1,320		
Single-Vehicle		0.110	0.100	0.011		1.020		
Segment 1		0.476	0 120	0.000	10	0.040	0.266	6.515
Veert 0005		0.470	0.138	0.338	10	0.910	0.300	0.015
rear1 2005		0.386	0.11/	0.269	10	0.910		
Year2 2006		0.447	0.132	0.315	10	0.910		
Year3 2007		0.507	0.146	0.361	10	0.910		
Year4 2008		0.565	0.159	0.406	10	0.910		
Segment 2		0.207	0.029	0.178	7	0.860	0.584	3.034
Year1 2005		0.199	0.028	0.171	7	0.860		
Year2 2006		0,206	0.029	0,177	7	0.860		
Year3 2007		0.206	0.029	0.177	7	0.860		
Vear4 -= 2008		0.200	0.032	0.187	7	0.860		
Multiple vehicle Drive	way Related	0.215	0.052	0.107		0.000		
Segment 1	way-neiateu	0.514	0.176	0.220	11	0.910	0.275	7.067
Segment 0005		0.014	0.170	0.330	44	0.010	0.375	1.001
Year1 2005		0.377	0.129	0.248	11	0.810		
Year2 2006		0.467	0.160	0.307	11	0.810		
Year3 2007		0.559	0.191	0.368	11	0.810		
Year4 2008		0.654	0.224	0.430	11	0.810		
						_		
		W	orksheet 4B P	redicted Pedest	rian and Bicycle			
			Crashes for Ur	rban and Suburb	an Arterials			
			(1)	(2)	(3)			
			Site Type	Nped	Nolke			
			ROA	DWAY SEGMENT	S			
		Segme	ent 1	0.042	0.015			
		Yea	r1 2005	0.031	0.011			
		Yea	r2 2006	0.038	0.014			
		Yea	r3 2007	0.045	0.017			
		Yea	r4 2008	0.053	0.020			
		Segme	ent 2	0.006	0.002			
		Yea	r1 2005	0.006	0.002			
		Yea	r2 2006	0.006	0.002			
		Yea	r3 2007	0.006	0.002			
		Yea	r4 2008	0.007	0.002			
			I	NTERSECTIONS				
		Interse	ection 1	0.009	0.004			
		Yea	r1 2005	0.035	0.017			
		Yea	r2 2006	0.000	0.000			
		Yea	r3 2007	0.000	0.000			
		Yea	r4 2008	0.000	0.000			
		Interse	ection 2	0.082	0.011			
		Yea	r1 2005	0.079	0.045			
		Yea	r2 2006	0.081	0.000			
		Yea	r3 2007	0.082	0.000			
		Yea	r4 2008	0.085	0.000			
		Interse	ection 3	0.002	0.002			
			-1 2005	0.009	0.009			
		Yea	112005					
		Yea Yea	r2 2005	0.000	0.000			
		Yea Yea Yea	r2 2005 r3 2006 r3 2007	0.000	0.000			
		Yea Yea Yea Yea	r2 2005 r3 2006 r3 2007 r4 2008	0.000 0.000 0.000	0.000 0.000 0.000			
		Yea Yea Yea COMB	r2 2005 r3 2006 r4 2008 INED (sum of colum	0.000 0.000 0.000 nn) 0.141	0.000 0.000 0.000 0.035			
		Yea Yea Yea COMB	r2 2005 r2 2006 r3 2007 r4 2008 INED (sum of colun	0.000 0.000 0.000 nn) 0.141	0.000 0.000 0.000 0.035			
		Yea Yea Yea COMB	r2 2005 r3 2007 r4 2008 NED (sum of colun	0.000 0.000 0.000 nn) 0.141	0.000 0.000 0.000 0.035			
	Worksł	Yea Yea Yea COMB	r2 2005 r3 2007 r3 2007 r4 2008 INED (sum of colum pecific EB Metho	0.000 0.000 0.000 nn) 0.141	0.000 0.000 0.000 0.035	nd Suburban Arte	rials	
(1)	Workst (2)	Yea Yea Yea COMB	11 2005 12 2006 13 2007 14 2008 INED (sum of colum pecific EB Methol (3)	0.000 0.000 0.000 0.141	0.000 0.000 0.035 sults for Urban at (4)	nd Suburban Arte	rials (5)	(6)
(1) everity level	Workst (2) N practicular	Yea Yea Yea COMB	11 2005 12 2006 13 2007 14 2008 NED (sum of colum pecific EB Methol (3) N pet	0.000 0.000 0.000 nn) 0.141	0.000 0.000 0.000 0.035 sults for Urban at (4) N bite	nd Suburban Arter	rials (5)	(6) Nepresident
(1) everity level	Workst (2) N predoted	Yea Yea Yea COMB	11 2005 12 2006 13 2007 14 2008 INED (sum of colum pecific EB Method (3) N ped mag from Workshee	0.000 0.000 0.000 nn) 0.141	0.000 0.000 0.000 0.035 sults for Urban at (4) N bike from Worksheet 4F	nd Suburban Arter	rials (5) ed (VEHICLE) orksheet 4A	(6) N especied (3)st(4)st(5)
(1) everity level (2	Workst (2) N predoted)cous from Works 9 2	Yea Yea Yea COMB comb heet 4C Site-S	11 2005 12 2006 13 2007 14 2008 NED (sum of column pecific EB Methol (3) N ped 0.1	0.000 0.000 0.000 0.141 0.141 0.141	0.000 0.000 0.000 0.035 sults for Urban at (4) N bits from Worksheet 4E 0.0	N espect	rials (5) ed (VEHICLE) forksheet 4A 8.8	(6) N espedad (3)+(4)+(5) 59.0
(1) everity level (2) injury (Fl) (3)	Workst (2) N presided)cous from Works 9.2)cous from Works	Yea Yea Yea COMB heet 4C Site-S heet 4A (2)c	11 - 2005 12 - 2006 13 - 2007 14 - 2008 NED (sum of colum pecific EB Methol (3) N ged 0.1 Nash from Workshee 0.1 Nash from Workshee	0.000 0.000 0.000 0.141 0.141 0.141 0.141 0.141 0.141 0.141	(4) (4) N sixe from Worksheet 4E 0.0	N especies (8) COMB W (5) FORTH * (rials (5) structure forksheet 4A i8.8 2) p(2) portu	(6) N especied (3)+(4)+(5) 59.0 (3)+(4)+(5)
(1) sverity level (2 injury (FI) (3	Workst (2)) _{cous} from Works 9.2) _{cous} from Works 2.9	Yea Yea Yea COMB construction heet 4C heet 4A (2) heet 4A (2)	11 - 2005 12 - 2006 13 - 2007 14 - 2008 NED (sum of colum pecific EB Method (3) N est 0:1 0:1 0:1 0:1	0.000 0.0000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000	0.000 0.000 0.000 0.035 0.035 (4) N bas from Worksheet 4ξ 0.0 from Worksheet 4ξ 0.0	N especie 8 (8)cous 9 (5)cous 10 (5)cous	rials (5) ed/VEHOLE) orksheet 4A 18.8 2) _{F1} (2) _{TOTAL} 8.5	(6) N especied (3)+(4)+(5) 59.0 (3)+(4)+(5) 18.7
(1) everity level (2) injury (FI) (3) damae only (700)	Workst (2) N presided)cous from Works 9.2)cous from Works 2.9)cous from Works	Yea Yea Yea COMB heet 4C Site-S heet 4A (2) _o heet 4A (2) _o	12 - 2005 13 - 2007 14 - 2008 NED (sum of colum pecific EB Method (3) N set 2008 from Workshee 0.1	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000	0.000 0.000 0.000 0.035 0.035 0.035 0.035 0.0 0.0 0.0 0.0 0.0 0.0 from Worksheet 4E 0.0	N especies (8) Course W (5) Course W (5) ToTAL* ((5) ToTAL* (rials (5) orkshet4A 8).8 (2).7 (2).707AL 8.5 (2).7 (2).707AL	(6) N especied (3)+(4)+(5) 59:0 (3)+(4)+(5) 18:7

Three buttons on the top right side of the summaries can be used to return to the main menu, and to hide and unhide unused rows.

Return to Main	
Hide Unused Rows	
Unhide Al Rows	

Note: Worksheets **UrbArt_3_Seg Tables** and **UrbArt_5_Int Tables** contain the HSM predictive method supporting tables. IDOT has developed state-specific values for all these different distributions and it is not necessary to use the HSM default values.

However, the IDOT HSM tool is flexible enough to allow modifications to such tables. Input data required from the user but restricted to **Yes** and **No** options are provided in the pull-down boxes (blue cells). Orange cells contain the locally-derived data.

		Table 12-4: D	istribution of M	ultiple-Vehicle	Nondriveway Col	lisions for Road	way Segments	by Manner of C	ollision Type			
Illinois-Specific	Van				Proportion of cra	shes by severi	ty level for spe	cific road types				
Values?	res	HSM-Provided Values										
		2	20		3T	4	4U	4	Ð	5	т	
Collision type		FI	PDO	FI	PDO	FI	PDO	FI	PDO	FI	PDO	
Rear-end collision		0.730	0.778	0.845	0.842	0.511	0.506	0.832	0.662	0.846	0.651	
Head-on collision		0.068	0.004	0.034	0.020	0.077	0.004	0.020	0.007	0.021	0.004	
Angle collision		0.085	0.079	0.069	0.020	0.181	0.130	0.040	0.036	0.050	0.059	
Sideswipe, same	direction	0.015	0.031	0.001	0.078	0.093	0.249	0.050	0.223	0.061	0.248	
Sideswipe, oppos	ite direction	0.073	0.055	0.017	0.020	0.082	0.031	0.010	0.001	0.004	0.009	
Other multiple-veh	icle collision	0.029	0.053	0.034	0.020	0.056	0.080	0.048	0.071	0.018	0.029	
Source: HSIS data fo	r Washington (200	2-2006)										
						Illinois-Spec	ific Values					
Collision type		2	0		3T	4	<u>iu</u>	4	D	5	<u>T</u>	
		FI	PDO	FI	PDO	FI	PDO	FI	PDO	FI	PDO	
Rear-end collision		0.527	0.512	0.714	0.621	0.536	0.437	0.558	0.487	0.459	0.455	
Head-on collision		0.092	0.017	0.012	0.004	0.044	0.010	0.036	0.007	0.039	0.005	
Angle collision		0.083	0.068	0.095	0.089	0.082	0.091	0.088	0.070	0.121	0.100	
Sideswipe, same	direction	0.058	0.161	0.048	0.102	0.088	0.230	0.082	0.220	0.058	0.169	
Sideswipe, oppos	ite direction	0.073	0.048	0.036	0.004	0.026	0.023	0.026	0.018	0.031	0.015	
Other multiple-veh	icle collision	0.166	0.193	0.095	0.179	0.223	0.208	0.211	0.198	0.293	0.256	
Note: HSM-Provide	d values based on	HSIS data for Wash	ington (2002-2006)									
			Table 12-6: Dist	tribution of Sin	gle-Vehicle Collis	ions for Roadwa	ay Segments by	Collision Type				
Illinois-Specific	Yes				Proportion of cra	ishes by severi	ty level for spe	cific road types				
Values?						HSM-Provid	ed Values		-	_		
		2	20		3T	4	40		40		51	
Collision type		FI	PDO	FI	PDO	H	PDO	FI	PDO	FI	PDO	
Collision with anim	nal	0.026	0.066	0.001	0.001	0.001	0.001	0.001	0.063	0.016	0.049	
Collision with fixed	d object	0.723	0.759	0.688	0.963	0.612	0.809	0.500	0.813	0.398	0.768	
Collision with othe	robject	0.010	0.013	0.001	0.001	0.020	0.029	0.028	0.016	0.005	0.061	
Other single-vehic	cie collision	0.241	0.162	0.310	0.035	0.367	0.161	0.4/1	0.108	0.581	0.122	
Source: HSIS data to	r Washington (200	2-2006)										
o				Illinois-specific values		40		-	-			
Collision type					31		10	4	0	5	0	
Collinian with only		FI 0.040	PD0	0.050	PD0	FI 0.025	PD0	FI 0.040	PD0	FI 0.048	PD0	
Collision with anin	IBI di a bila ak	0.040	0.220	0.050	0.076	0.035	0.109	0.040	0.107	0.010	0.120	
Collision with fixed	d object	0.613	0.332	0.000	0.400	0.000	0.400	0.706	0.404	0.762	0.517	
Other eingle webie	er object	0.029	0.032	0.050	0.056	0.029	0.045	0.031	0.054	0.018	0.086	
Other single-venic	LIE CUIISIUII	0.311	0.410	0.100	0.407	0.201	0.300	0.217	0.295	0.102	0.211	
		Tabl	la 42 % Dadaate	ion Crook Adiu	etmont Easter for	Deadway Coar	onto					
Table 12-0: Pedestrian Crasin Adjustment ractor for Koadway segments												
Minus-specific Yes Persided Veloce Windows Crash Adjustment ractor (1 _{pdd})												
values: HSM-Provided Values IIIInois-Specific Values												
коай туре		osted speed 3	o mpn or Lowe	osted speed (areater than 30 m	prosted speed a	of mpn or Lowe	sied speed Gr	eater than 30 m			
20		0.0	0.00		0.005	0.	014	0.	103			
3T		0.0	141		0.013	0.	041	0.	200			
40		0.0	J22		0.009	0.	019	0.0	007			
4D		0.0	101		0.019	0.	010	0.0	107			

STEP 13: To print the summary, export data, or make changes, click on the Return to Main button on the top right side of the summary tabs. This will prompt the main menu. Click on the Output Data tab.

Urban an	d Suburban Arterials	And Persons in case of	X
1	Illinois D	epartment of	Transportation
- Inp	out Data Ou	tput Data	-
	Show Detailed Analysis	Show Calculations	Print Preview
2	Export Data	Edit/Change Analysis	Help
AAS			Exit HSM Tool

The following buttons are available:

- Show Detailed Analysis: Displays the background summary calculations.
- **Show Calculations:** Displays the predictive method calculations (tabs) for each facility included in the analysis.
- **Print Preview:** Prepares the summary sheet for printing.
- **Export Data:** Creates a copy of the spreadsheet.
- Edit/Change Analysis: Allows the user to make changes, including adding facilities, changing values, and re-running the set-up process.
- Help: Provides a hyperlink to the IDOT HSM Tool User's Manual posted on IDOT website.

Details about these utilities are provided in Chapter 4.

3.4 Calculation of Expected Crash Frequency for a Future Time Period

3.4.1 Introduction

HSM Appendix A.2.6 provides a methodology to adjust the estimated value of expected average crash frequency to a future time period. The methodology accounts for any before and after changes including: any difference in the duration of the before and after periods, growth or decline in AADT, and changes in geometric design or traffic control features that may have an effect in the CMFs.

3.4.2 Example

In this example, the 2030 expected average crash frequency for a rural two-lane, two-way segment is calculated, as listed in Table 8. The before study period is 2009 to 2012, and the future period is the year 2030.

Input Data				
Segments Characteristics	Segment 1			
Segment length (miles)	1.50			
Traffic volume (veh/day) (2010 AADT)	9,000			
Lane width (ft)	12			
Shoulder width (ft)	4			
Shoulder type	Paved			
Length of horizontal curve (miles)	0			
Radius of curvature (ft)	0			
Spiral transition curve	Not present			
Superelevation variance (ft/ft)	0			
Grade (%)	2			
Driveway density	1.7			
Centerline rumble strips	Not present			
Passing lanes	Not present			
Two-way left-turn lane	Not present			
Roadside hazard rating	5			
Segment lighting	Not present			
Auto speed enforcement	Not present			
KABC - Fatal and Injury Only Crashes. (observed crashes/year)	12			
PDO - Property Damage Only Crashes. (observed crashes/year)	15			

TABLE 7 Rural Two-Lane, Two-Way Segment Input Data **STEP 1:** The screen capture below shows the opening page of the IDOT HSM tool. Click on the **Rural Two-Lane, Two-Way Roads** button to begin with the analysis.

1. Plea	se select the District where this project is located.
0	District 1
œ	District 2 to District 9
2. Wha Fror To	t is the study period of the analysis? (max 5 years) n 2009 2012 2012
3. Wha	t is the facility type?
۲	Rural Two-Lane, Two-Way Roads
C	Rural Multilane Highways
C	Urban and Suburban Arterials

STEP 2: The Main Menu window opens up. Select the Load Input Data from Table button.

Rural Two	o-Lane, Two-Way Roads	epartment of tput Data	Transportation			
	Load from Table	Step 1	Step 2			
2	Load Input Data from Table	New Project	Project Information			
	Step 3	Step 4	Step 5			
	Segment Input	Intersection Input	Set up Spreadsheet			
-44.00						
AASHO Exit HSM Tool						

STEP 3: The Analysis Input user form opens up. Input the information requested in the fields as follows. The **Total Number of Segments** is 1. The **Study Period** will be already pre-populated. For this analysis AADT for each analysis year is available, select **Enter AADT for Each Year** by clicking on the circle next to the text. If the latter is selected, a new window will open informing that AADT for each year must be entered in Steps 3 and 4.

Analysis Method: Observed crash data are available; therefore, the user can select **Estimate Expected Number of Crashes** by clicking on the circle next to the text.

The **Observed Crash Data by Site Available** option is used when available crash data are disaggregated by site (segments and/or intersections). Select this option.

IDOT HSM Crash Prediction Tool

Rural Two-Lane, Two-Way Roads Analysis Input	x
Analysis Input :	
Total Number of Segments : 1	3
Total Number of Intersections :	-
Study Period : From 2009 to 2012	
Multiyear Analysis	_
Apply Linear Traffic Growth Factor (%)	
Enter AADT for Each Year	
Analysis Method	
Estimate Predicted Number of Crashes:	
Estimate Expected Number of Crashes:	
Analysis Report	
Observed Crash Data by Site Available:	
Observed Crash Data for the Project Available:	
Return to Main	

When complete, click on the **Return to Main** button.

STEP 4: The tab TLR_3_Seg_Input tab opens up. Fill up the segment data.

Project Description	Segment A			
Analyst	DPB			
Agency or Company	IDOT	IDOT		
State	IL			
Date Performed	9/2/2013			
Jurisdiction	D2			
Study Period	2009-2012			
Roadway	Segment A			
Segment Name	Select Segment	Segment 1		
Roadway		Segment A		
Roadway Segment		MP 1.0 - 2.5		
Segment Length (mi)		1.5		
Lane width (ft)		12		
Shoulder width (ft)	6	4		
Shoulder type	Paved	Paved		
Length of horizontal curve (mi)		0.0		
Radius of curvature (ft)		0		
Spiral transition curve (present/not present)	Not Present	Not Present		
Superelevation variance (ft/ft)		0		
Grade (%)		2		
Driveway density (driveways/mile)		1.7		
Centerline rumble strips (present/not present)	Not Present	Not Present		
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present		
Two-way left-turn lane (present/not present)	Not Present	Not Present		
Roadside hazard rating (1-7 scale)	3	5		
Segment lighting (present/not present)	Not Present	Not Present		
Auto speed enforcement (present/not present)	Not Present	Not Present		
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		12		
PDO - Property Damage Only Crashes. (observed crashes/year)		15		
KABCO - Total Crashes (crashes/year)		27		
MULTIYEAR ANALYSIS				
Segment Name		Segment 1		
Note that as part of the input data; only 2010 AADT is available; therefore, an additional calculation step is needed to come up with the 2009 AADT. It is important to remember that the tool requires using AADT for the first year of the study period.

STEP 5: Click on the **AADT Calculation** tab. The study period includes 4 years from 2009 to 2011. Therefore year 2010 is the second year of analysis. Assume a growth rate of 0.5 percent per year. In the AADT Calculation tab, enter the requested information.

_	_	_	_	-	_	
ase enter y	our answe	rs into the	blue cells	in order t	o calculate	AADT.
Which yea	r AADT is a	available? E	ig. Input 2 i	f second ye	ear.	
2						
What is th	e available /	AADT?				
9000						
What is th	e growth rat	te?				
0.005						
culated AAI	DT for five	years:				
Year 1	8955					
Year 2	9000					
Year 3	9045					
Year 4	9090					
	Which yea 2 What is th 9000 What is th 0.005 Culated AAI Year 1 Year 2 Year 3 Year 4	Which year AADT is a 2 What is the available 9000 What is the growth rat 0.005 Culated AADT for five Year 1 8955 Year 2 9000 Year 3 9045 Year 4 9090	ase enter your answers into the Which year AADT is available? E 2 What is the available AADT? 9000 What is the growth rate? 0.005 culated AADT for five years: Year 1 8955 Year 2 9000 Year 3 9045 Year 4 9090	ase enter your answers into the blue cells Which year AADT is available? Eg. Input 2 in 2 What is the available AADT? 9000 What is the growth rate? 0.005 culated AADT for five years: Year 1 8955 Year 2 9000 Year 3 9045 Year 4 9090	ase enter your answers into the blue cells in order to Which year AADT is available? Eg. Input 2 if second years What is the available AADT? 9000 What is the growth rate? 0.005 culated AADT for five years: Year 1 8955 Year 2 9000 Year 3 9045 Year 4 9090	ase enter your answers into the blue cells in order to calculate Which year AADT is available? Eg. Input 2 if second year. 2 What is the available AADT? 9000 What is the growth rate? 0.005 culated AADT for five years: Year 1 8955 Year 2 9000 Year 3 9045 Year 4 9090

STEP 6: Copy the AADT values and return to the TLR_3_Seg_Input, and finish entering the segment data. Click the **Load Data** button.

Project Description	Segment A	
Analyst	DPB	
Agency or Company	IDOT	
State	IL	
Date Performed	9/2/2013	
Jurisdiction	D2	
Study Period	2009-2012	
Roadway	Seament A	
· · · · · · · · · · · · · · · · · · ·		
Segment Name	Select Segment	Segment 1
Roadway		Segment A
Roadway Segment		MP 1.0 - 2.5
Segment Length (mi)		1.5
Lane width (ft)		12
Shoulder width (ft)	6	4
Shoulder type	Paved	Paved
Length of horizontal curve (mi)		0.0
Radius of curvature (ft)		0
Spiral transition curve (present/not present)	Not Present	Not Present
Superelevation variance (ft/ft)		0
Grade (%)		2
Driveway density (driveways/mile)		1.7
Centerline rumble strips (present/not present)	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present
Roadside hazard rating (1-7 scale)	3	5
Segment lighting (present/not present)	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present
KABC - Fatal and Injury Only Crashes. (observed crashes/year)		12
PDO - Property Damage Only Crashes. (observed crashes/year)		15
KABCO - Total Crashes (crashes/year)		27
MULTIYEAR ANALYSIS		
Segment Name		Segment 1
AADT 2009		8,955
AADT 2010		9,000
AADT 2011		0.045

STEP 7: Once the tool finish running, Click OK, and the summary tab appears.

AADT 2012



Click Hide Unused Rows to display only the cells with data related to the analysis.

9,090



STEP 8: Select the **Return to Main** button, and go to the **Output Data** tab. Select the **Show Calculations** to display the background calculation tab. Crash Modification Factors will be extracted from this tab to compute the future expected average crash frequency.

IDOT HSM Crash Prediction Tool

Rural Tw	o-Lane,Two-Way Roads		×
1	Illinois D	epartment of	Transportation
n In	put Data Out	tput Data	
	Show Detailed Analysis	Show Calculations	Print Preview
	Export Data	Edit/Change Analysis	Help
			Exit HSM Tool

STEP 9: The next step is to calculate the predicted average crash frequency for year 2030. Repeat Steps 1 through 4, except Step 3. The analysis method is different for the future condition because observed crash data are not available. Select **Estimate Predicted Number of Crashes** by clicking on the circle next to the text.

Getting Started
 Please select the District where this project is located. District 1 District 2 to District 9
2. What is the study period of the analysis? (max 5 years) From 2030 To 2030
3. What is the facility type?
Start Analysis

Rural Two-Lane, Two-Way Roads Analysis Input	X
Analysis Input : Total Number of Segments :	÷
Total Number of Intersections :	<u>·</u>
Study Period : From 2030 to 203	30
Multiyear Analysis Apply Linear Traffic Growth Factor (%)	С
Enter AADT for Each Year	0
Analysis Method Estimate Predicted Number of Crashes: Estimate Expected Number of Crashes:	• •
Return to Ma	ain

STEP 10: Click on the **AADT Calculation** tab. This time, calculate the AADT for a future time period. The 2010 AADT is 9000. Assume a growth rate of 0.5 percent per year, and enter the following information:

Spe	ecial Case:	Calculate	AADT for	a future y	ear.			
1.	Which yea	r AADT is a	available? E	Eg. Input "2	010" if 2010	AADT is a	vailable.	
	2010							
2.	What is th	e available .	AADT?					
	9000							
3.	What is th	e growth ra	te?					
	0.50%							
4.	Which futu	re year AA	DT do you	need? Eg.	Input "2020'	' if need AA	DT for the	year 2020.
	2030							
Cal	culated AA	DT for the	future ye	ar:				
	Year:	2030	-					
	AADT:	9944						

STEP 11: Copy the 2030 AADT and return to the TLR_3_Seg_Input, and finish entering the segment data. Click the **Load Data** button to run the analysis.

Project Description	Segment A	
Analyst	DPB	
Agency or Company IDOT		
State	IL	
Date Performed	9/2/2013	
Jurisdiction	D2	
Study Period	2009-2012	
Roadway	Segment A	
Segment Name	Select Segment	Segment 1
Roadway		Segment A
Roadway Segment		MP 1.0 - 2.5
Segment Length (mi)		1.5
AADT (veh/day)		9,944
Lane width (ft)		12
Shoulder width (ft)	6	4
Shoulder type	Paved	Paved
Length of horizontal curve (mi)		0.0
Radius of curvature (ft)		0
Spiral transition curve (present/not present)	Not Present	Not Present
Superelevation variance (ft/ft)		0
Grade (%)		2
Driveway density (driveways/mile)		1.7
Centerline rumble strips (present/not present)	Not Present	Not Present
Passing lanes [present (1 lane) /present (2 lane) / not present)]	Not Present	Not Present
Two-way left-turn lane (present/not present)	Not Present	Not Present
Roadside hazard rating (1-7 scale)	3	5
Segment lighting (present/not present)	Not Present	Not Present
Auto speed enforcement (present/not present)	Not Present	Not Present
Load Data Print Input Ir	nfo	

STEP 12: Once the tool finish running, Click OK, and the summary tab appears.

CH2MHILL	Tw	o Lane Rural Roads S	ummary Sheet	Cite Tue		Return to Main
A 1 1	Worksneet 3A	Predicted Crashes I	by Severity and	i Site Type		-
Analyst	UPB		Roadway	Segment A		
Agency or Company			Junsaiction	02		Hide Unused
Date Performed	9/2/2013		Study Period	2009-2012		Rows
Project Description	Segment A					
						Unhide All Rows
(1)		(2)	(3)	(4)		
		Predicted average	crash frequency	y (crashes/ye	ar)	
Site ty	/pe	N predicted (TOTAL)	N predicted	N predicte	ed	
	RC	DADWAY SEGMENTS	(1)	(100)		
Segment 1		7 069	2 269	4 800		
Year1 2030		7.069	2.269	4,800		
		INTERSECTIONS				
COMBINED (sum of	column)	7.069	2,269	4.800	_	
	, 					
	Workst	agent 3B Site Specific	Summany Doc	ulte		
	WORKSI	ieer 50 Site-Specific	, summary Kes	uits		
				N predicte	ed	
	Crash severity le	evel	Predicte	d average ci	rash frequency	
				(crashes/	yr)	
Total				7.069		
Fatal and Injury (FI)				2.269		
Property Damage Or	ily (PDO)			4.800		
	_			_		
	Prec	dicted Crashes	by Severi	ty		
8 000						
5						
5 7.000 -						
2 6.000 -				I	Total	
L 5 000						
E 5.000				-	Fatal and Injury (FI)	
4.000				<u> </u>		
S 3.000 -				- I	Property Damage	
Av					Only (PDO)	
2.000						
- 1.000 -						
<u>د</u> 0.000						
	Total	Fatal and Iniury (F	I) Property Da	mage Only		
		274-	(PD	0) (0		

STEP 13: Repeat Step 8. Select the **Return to Main** button, and go to the **Output Data** tab. Select the **Show Calculations** to display the background calculation tab. Crash Modification Factors will be extracted from this tab to compute the future expected average crash frequency.

Rural	Rural Two-Lane, Two-Way Roads					
6	Millinois D	epartment of	Transportation			
	nput Data Out	tput Data				
	iput Dutu	• · · · · · · · · · ·				
2	Show Detailed Analysis	Show Calculations	Print Preview			
A 4	Export Data	Edit/Change Analysis	Help			
			Exit HSM Tool			

STEP 14: The predicted and expected crashes frequencies for the before and after periods are listed below.

Crashes	Before Period	After Period
Predicted Crash Frequency	6.4	7.1
Expected Crash Frequency	22.9	Unknown

Similarly, the CMFs for both analyses are listed below. Since the only change is the AADT, the CMDs for both periods remain the same.

CMF	Before Period	After Period
CMF 1r	1.00	1.00
CMF 2r	1.06	1.06
CMF 3r	1.00	1.00
CMF 4r	1.00	1.00
CMR 5r	1.00	1.00
CMF 6r	1.00	1.00
CMF 7r	1.00	1.00
CMF 8r	1.00	1.00
CMF 9r	1.00	1.00
CMF 10r	1.14	1.14
CMF 11r	1.00	1.00
CMF 12r	1.00	1.00

STEP 15: The 2030 expected average crash frequency can be calculated based on HSM equation A-15 page A-23.

$$N_f = N_p \left(\frac{N_{bf}}{N_{bp}}\right) \left(\frac{CMF_{1f}}{CMF_{1p}}\right) \left(\frac{CMF_{2f}}{CMF_{2p}}\right) \cdots \left(\frac{CMF_{nf}}{CMF_{np}}\right)$$

Where:

- N_f expected average crash frequency during the future time period for which crashes are being forecasted
- N_p expected average crash frequency for the past time period for which observed crash history data were available
- N_{bf} number of crashes predicted by the SPF using the future AADT data, the specified nominal values for the geometric parameters, and segment length (in the case of roadway segments)
- N_{bp} number of crashes predicted by the SPF using the past AADT data, the specified nominal values for geometric parameters, and the segment length (in the case of roadway segments)
- CMF_{nf} value of the nth CMF for the geometric conditions planned for the future design

 CMF_{np} value of the nth CMF for the geometric conditions for the past design

Replacing the values obtained from the two analyses, the 2030 expected average crash frequency is calculated as follows:

$$N_f = 22.9 \left(\frac{7.1}{6.4}\right) \left(\frac{1.00}{1.00}\right) \left(\frac{1.06}{1.06}\right) \cdots \left(\frac{1.00}{1.00}\right)$$

 $N_f = 25.2$

This process can be repeated for as many years as needed as long as the future AADT information is available. For more information about the limitations of this methodology, please refer to the HSM Appendix A.2.6 page A-22.

Utilities

Another major change in this new version is the utility functions. The Output Data utilities functions have been expanded and now include Show Detailed Analysis, Show Calculations, Print Preview, Export Data, Edit/Change Analysis, and Help Menu options.

The following examples demonstrate what steps are required to apply the utility functions. This method is similar for all three modules (rural two-lane, rural multilane, and urban and suburban arterials).

4.1 Show Detailed Analysis

The Show Detailed Analysis option allows the user to enter data for all segments and intersections in a table format facilitating the data entry process.

This example is a continuation of the Chapter 3.2 Rural Multilane Highways.

Once the Set up Spreadsheet procedure has been run and the analysis is completed, the user has the option to unhide the summary containing the calculations.

Go back to any summary sheet, and click on **Return to Main**. In the main menu, go to the **Output Data** tab.

Rural Multilane Highways	epartment o put Data	of Transportation	
Show Detailed Analysis	Show Calculations	Print Preview	
Export Data	Edit/Change Analysis	Help	
ААБНІО		Exit HSM Tool	

Click on the **Show Detailed Analysis** button, to unhide the summary worksheet. A user form will pop up providing details about the tab containing the desired summary sheet.

1	Microsoft Excel
	Detailed Analysis located in tab MLR_9_RuralMultiLn_Proj_EB_Tot
	ОК

After clicking **OK**, the user form will close down, taking the user back to the main menu.

Close the main menu by clicking on the **X** located in the top right corner of the user form to access the summary sheet.

	-	
Show Detailed Analysis	Show Calculations	Print Preview
Export Data	Edit/Change Analysis	Help

Tab **MLR_9_RuralMultiLn_Proj_EB_Tot** contains the predicted, expected, and observed crashes for all the facilities included in the analysis.

CH2MHILL.	Vo	rkshee	t 5A Predic	ted and Obs	Multilane Ru erved Crashes	ral Roads Summ s by Severity and	ary Sheet Site Type Usi	ng the Projec	t-Level EB	Method			
Analyst CC							Roadway	Skokie Ave					
Agency or Company IDO	т						Jurisdiction	District 2					
Date Performed 9/4/	2013						Studu Period	2009 to 2012					
Project Description Sko	kie Ave Anlusis						,						
(1)	(2	2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Cit- 1	Pred	licted a	average crash crashes/year	frequency	Observed crashes,	Overdispersion	N	N_1	٧.	Ν.	٧,	N,	N.,
one type	N,	6.6.4 10	Nyssatatea	N _{pertint} at (RDO)	N.td (crashes/liear)	Parameter, k	Equation A-8	Equation A-9	Equation	Equation	Equation	Equation	Equation
	[[[0]	ALJ	(FI)	(PDO)	DOADVA			244((0) (2))	A-10	A-11	M-12	- M-10	0.14
Common 1 (Divide d)		77	0.000	0.504	HUADWA	T SEGMENTS DI		0.570					
Segment I (Divided)	1.0	57	0.602	0.504		0.004	0.372	0.579					
Yeari 2009	1.0	00	0.575	0.476		0.304	0.335	0.060					
Tear2 2010	1.0	88 DE	0.083	0.435		0.304	0.359	0.575					
Tear3 2011	1.6	20	0.612	0.513		0.304	0.384	0.564					
Year4 2012	1.10	52	0.630	0.532		0.304	0.410	0.594					
			1700		RUADWAY	SEGMENTS UNL	NAIDED						
Segment I (Unaividea)	2.8	53	1.783	1.086		0.450	1.291	0.669					
Year1 2003	2.6	58	1.661	0.997	-	0.106	1.103	0.644					
Tear2 2010	2.1	63	1.721	1.041		0.106	1.131	0.657					
Tears 2011	2.0	00	1.782	1.060		0.106	1.209	0.663					
Year4 2012	۵.1	86	1.366	1.221		0.106	1.080	0.705					
1			0.044	0 540	IN	TERSECTIONS	0.700	0.705					
Intersection 1	1.16	57 0 5	0.641	0.546			0.703	0.765					
Year1 2009	1.0	25	0.543	0.482		0.494	0.519	0.712					
Year2 2010	1.1	30	0.607	0.523		0.494	0.631	0.747					
Year3 2011	1.2	32	0.669	0.063		0.494	0.750	0.780					
Year4 2012	1.3	03	0.744	0.615		0.434	0.912	0.819					
Intersection 2	0.1	87	0.074	0.113		0.400	0.016	0.233					
Tear1 2003	0.1	63 70	0.067	0.101		0.460	0.013	0.273					
Year2 2010	0.1	/9	0.071	0.107		0.460	0.015	0.287					
Year3 2011	0.1	89	0.075	0.114		0.460	0.016	0.295					
Tears 2012	0.2	12	0.084	0.128		0.460	0.021	0.312					
COMBINED (sum of cold	umnj 5.3	49	3.100	2.249	25		Z.38Z	2.306	0.692	11.404	0.699	11.268	11.336
	Vor	ksheel	4B Projec	t-Level EB M	lethod Summa	ry Results							
,	m			(2)			(3)						
Crash severity level				Nanatara		İ	Name						
Total			(2)	from Work ch	not 50	(12)	from Work choo	F0					
i otar			[4]00	5 3		(IS)CONE	11.3						
Eatal and injury (EI)			(22)	(and 1)			* (2) _ L (2)						
r atarana injuly (FI)			[3]cor	10 HOLD WORKShi	eet oA	[3]10		AL					
Property damage only (P)	00)		(0)	3.1 (and Vert 1		(0)	• (2) 1 (22)						
	,		[4]cor	ap nom workshi	eet JA	[J]TOT	AL (CJPDOF(C) TOT	rel					
				2.2			4.8						

4.2 Show Calculations

The **Show Calculations** button is used to access the detailed calculations of each segment and intersection. The screen captures below are the continuation of the rural multilane highways example from Section 3.2 of the manual. By clicking on this button, the user will unhide the templates containing the HSM predictive method calculations used for the analysis.

Rural Mu	Itilane Highways			×
(s) Inp	out Data Ou	tput Data	<i>Transportation</i>	
à	Show Detailed Analysis	Show Calculations	Print Preview	
	Export Data	Edit/Change Analysis	Help	
AAS			Exit HSM Tool	

After clicking on the **Show Calculations** button, the following message box pops up, indicating that the process is completed. Click **OK** to continue.

Microsoft Excel	×
Calculations are found in the segment and intersection to	ne individual abs
	ОК

After this user form and the main menu are closed, the individual segment and intersection tabs can be accessed.

MLR_2_Rural Div MultiLn Seg 1	MLR_3_Rural Und MultiLn Seg 1	7
MLR_5_Rural MultiLn Int 1	MLR_5_Rural MultiLn Int 2	

					_							
¥	arkshoot 1	A 6+s+	ral Inform	ation and	Input D	ata far l	Raral Mal	tilans R	reducy S	equestr.		
	General	Informat				Lucation Information						
Project Description			Ski	akie Ave Anlys	rir	Readua;	r			Ske	kia Ava	
Analyzt				cc		Readua;	Section			M	° 12.5	
Agency or Company				IDOT		Jurindict	ion			Dir	trict2	
State				IL IL		Study Pa	riad			2008	ta 2012	
Date Performed		09/04/13										
	lag	ut Data				Bars C	<u>anditian</u> r		5	ite Candi	timer	
SegmentName								Segment1				
Roadway type (divided fundi	ividad)					Di	ividad					
Longth of segment, L (mi)								0.7				
AADT (vohřday)								6,000				
Lane uidth (ft)							12	12				
Shoulder uidth (ft) - rightshi	oulder width f	iar divided [if	ⁱ diffor far di	irections of tr	avol, uro a		\$			6		
Shoulder type - rightshoulde	er type far div	idad				P	avod			Pavad		
Madian uidth (ft) - for divida	danly						30			20		
Side Sloper - for undivided or	nly						r flattor					
Lighting (prozent/not prozen	a)					Not	Prosont			NotPrese	int	
Autospeed enforcement (pr	osontfnat pro	vont)				Not	Prosont			NotPrese	nt	
Calibration Factor, Cr							1.00			1.28		
¥=.	rkrkeet 1B	(a) Cra	u L Madifi	cation Fac	ters fer	Rural I	lultilans	Dividad	Reeduey	Sequent	<u>r</u>	
(1)		(2)		(3))		(4)		(5)		(6)	
CMF for Lane Width	CMF for	Right Should	lor Width	CMF for Med	lian Width	CMF fe	ar Lighting	CMF 6	ar Automati	od Spood 👘	Combined CMF	
									Enforcomo	nt		
CANF IN 8		CMF 278		CM#3	\$rd	0	15 400		CMF 5+ d		CMF comb	
from Equation 11-16	fi	am Table 11-	17	fram Tab	le 11-18	fram Ea	uation 11-17	fr	am Section	11.7.2	(1)*(2)*(3)*(4)*(5)	
1.00		1.04		1.03	2		1.00		1.00		1.06	
¥.,	rkrhaat 10	: (a) Ra	aduay Sa	gmant Cra	rkes far	Rural M	lultilans I	Dividad	Reedway	Sequent	r	
(1)	(2)			(3)			(4)		(5)	(6)	(7)	
Crark Severity Level	SPI	Caeffici	entr	Hapf	rd.	Overdi	ispersion	C	bined	Calibra	Predicted	
1	ŕ	rom Table 11.	·5	1 -		Para	neter, k	(6)fram	Warkshoot	tinn	average crark	
1	a	b	-	from Equation 11-9		fromEq	uation 11-10	1B(a)		Factor,	(3)*(5)*(6)	
Total	-9.025	1.049	1.549	0.77	'4	0	.304	1	.06	1.28	1.051	
Fatal and Injury (FI)	-8.837	0.958	1.687	0.42	3	0	.264	1	.06	1.28	0.575	
Fatal and Injury" (FI*)	-8,505	0.874	1.740	0.28	:4	(0.251	1	.06	1.28	0.386	
Property Damage Only											(7) 70701 - (7)81	
(PD0)											0.476	
HOTE: U.S., IL- KORCO I- IL-					-: 1.1 - : - : 1							
Varkshaat 1	D (a) Cr	arhar ha S	ianarity I	and and C	Illirian	Tree fo	r Baral H	altilana	Disidad	Buadway	Samante	
(1)	(2)		31	(4)	(5)	(6)		7)	(8)	(9)	
Callizina Tras	Presert	Maradic		Preserti	Hara	e) dictad	Presert	Harad	Second re	Presert	M	
	ins of	(TO	TAL 1			ITTI.	1		143	ing of		
	C-Uiri-	Gerarka		C-Uirian	Cornet		C-Uiri-			C-Uiri-	1+++1	
	From Table	(7)	. Warkshaat	from Table	(7)	from.	from Table	(7)	fram.	from Table	(7) as from Workshoot	
	11-6	10	(a)	11-6	Washek		11-6	Martin 1		11-6	10(a)	
Total	1.002	1	151	1 000	0	575	1 000	A DECEMBER OF	226	0.999	0 476	
1844	1.002	(2)*0	2		(4)	/E)		(4.)	(7)	v	(2)*(2)	
	0.00F		JTOTAL		(4)×	(9)M	0.040	(0)	000		(*) (7) PD0	
Head-on colligion	0.005	0.0	105	0.016	0.0	009	0.019	0.	007	0.002	0.001	
Sideruipe colligion	0.053	0.0	156	0.069	0.	040 0.063		0.	024	0.049	0.023	
Rear-ond collizion	0.079	0.0	183	0.186	0.	107	0.190	0.	073	0.056	0.027	
Angle colligion	0.004	0.0	004	0.000	0.0	000	0.000	0.	000	0.004	0.002	
Single-vehicle colligion	0.834	0.3	<u>8777</u>	0.681	0.	391	0.677	0	.261	0.866	0.413	
Other colligion	0.027	1 0.0	128	0.048	0.0	028	0.051	U. U.	020	0.022	0.010	
HOTE: "Uning the KADCO anale, the	ar issladr asly l	(AD ersebre, C.	anken uilk sen	eeilg leael C (paa	aible injaral	are collisate	eded.					
Harded and the second												
	Ψ.	irkrheet 1	L Same	sary Baral	tr før Re	iral Mal	tilans Ra-	eduay S	equestr.			
(1)				(2)			r —	(3)		-	(4)	
Grack severity level		dicted av	erage cre	urk fraqua	6C7 (CF4	rkestye	peduey s	equest	angth (m	Crark rat	e (crarkestmitzear)	
-		L	(7) from Wi	arkrhoot 1C (a	i) ar (b)		—				(2)/(3)	
Tatal		L		1.1			—	0.7			1.5	
Fatal and Injury (FI)		L		0.6			—	0.7			0.8	
Fatal and Injury" (FI")				0.4				0.7			0.6	
LEensorty Damage Only (PDO				05				0.7			07	

HOTE: "Using the KAPCO usale, there include only KAP araskes. Crashes with accessing level C (passible injury) are not included.

These tabs contain the input data for all the facilities included in the analysis.

As a new feature, if the study period is a crossover between calibration datasets (analysis years include years 2008 and 2009), the Show Calculation feature in the main file will display the following message:



Archive_Period_1.xIsm and **Archive_Period_2.xIsm** files contain the background calculations for this type of analysis. These files are stored under the same location where the tool is saved inside a folder named **Archive** followed by the date and time of the analysis.

4.3 Print Preview

The **Print Preview** button is used to set up the summary sheet for printing. After running this utility, the summary will be displayed in Page Break View format.

Go back to any summary sheet, and click on **Return to Main**. In the main menu, go to the **Output Data** tab. Click the **Print Preview** button to run this utility.

Rural M	Illinois De put Data Out	epartment o put Data	of Transportation	
1	Show Detailed Analysis	Show Calculations	Print Preview	
	Export Data	Edit/Change Analysis	Help	
- 443	анро Сара	NX	Exit HSM Tool	

After the process is done running, a message box will pop up indicating the Summary sheet print preview is ready.

Microsoft Excel	×
Summary sheet pr	int preview
	ОК

The user can make changes as needed before sending the print preview page to the printer.



This page is set to fit into one page letter size paper. The user can use Excel's Page Layout functions to modify the page setup.



To modify the print area, go to Page Layout, and choose Print Area in Page Setup as shown above.

The user could also go back to the main menu to perform other actions by clicking on the **Return to Main** button.

4.4 Export Data

This function can be used anytime during the analysis. Following the Chapter 3.2 example, the main menu **Output Data** tab includes the **Export Data** option, which allows the user to export the data and save/create a copy of the analysis.

Rural Two-Lane, Two-Way Roads	epartment o put Data	of Transportation
Show Detailed Analysis	Show Calculations	Print Preview
Export Data	Edit/Change Analysis	Help
		Exit HSM Tool

When the **Export Data** button is clicked, the user will be directed to the following screen to save a copy of the analysis. Select a preferred file name and location.

x Save As		A COLUMN TWO IS NOT			
😋 🔵 🗢 🕌 🔸 CorridorAnalysis					👻 🍫 Search CorridorAnalysis
Organize 🔻 New folder)= • Q
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File name: TLR_Analysis_06102013					
Save as type: Excel Macro Enabled Wo	rkbook (*.xlsm)				
Authors: Dante Perez-Bravo	Tags: Add a tag	Title: Add a title	Subject: Specify the subject	Manager: Specify the manager	Company: CH2M HILL
Hide Folders					Toojs 🔻 Save Cancel

After pressing the **Save** button, a copy of the spreadsheet containing the analysis is created in the specified location. Once the process is complete, two message boxes open up indicating the file has been saved, and providing instructions on how to proceed.

Microsoft Excel	Microsoft Excel
Data saved to file	If you would like to modify the input data, go to the individual tabs. Make sure to save the file when complete!
ОК	OK

4.5 Edit/Change Analysis

The **Edit/Change Analysis** button is a new function that allows the user to modify an existing analysis. Once the user has run the Set up Spreadsheet in the user form approach, or has run the process using the Load Data button, the analysis has been completed. With the Edit/Change utility, the user can make changes such as adding or deleting facilities from the analysis, including additional crash data to run the EB adjustments methods, or applying a growth factor instead of entering AADT for each year, among many other options.

Without running this utility, the user can make very minor changes to the template worksheets containing the HSM predictive method calculations. Any other major change can only be completed/run using the Edit/Change Utility.

STEP 1: Press the Return to Main button located in any summary page to go back to the main menu.

Urban and Suburban Arterials					
Illinois Department of Transportation					
<mark>-</mark> Inp	out Data Out	put Data			
1	Show Detailed Analysis	Show Calculations	Print Preview		
	Export Data	Edit/Change Analysis	Help		

STEP 2: The user is given the option to confirm whether they want to move forward with making changes to the analysis. Note that once the process is started, the tool will be reset, and the analysis will be deleted. However, the data entered for the original analysis will be maintained.

After pressing the **Edit/Change Analysis** button, a message box appears asking whether the user wants to proceed with modifying the existing analysis.



Press No to cancel modifying the analysis.

Press **Yes** to continue with the changes. The analysis will be reset, but the input data will be retained. If the analysis included multiple facilities (more than one segment /intersection) the following message box will appear asking permission to delete the tabs that were created during the set-up process. The tool needs only one template tab for each facility to run. Click on **Delete** as many times as needed to complete the process.



STEP 3: After all the unnecessary tabs are deleted, another message box indicating that reset process is now completed will appear.



STEP 4: Press **OK** and then close the main menu. This will take the user back to the opening page of the IDOT HSM tool. Click on the **Go to Office** button, and click **Save**. Now the tool has been reset and is ready for editing and updating, while the segment and intersection original data the user has entered previously is still saved in the tool.



The tool is now ready to be modified. Repeat the steps used in the original analysis and make necessary changes as needed.

NOTE: To re-start a new analysis, click the **Getting Started** button.

4.6 Help Menu

The Help Menu provides various resources for addressing questions and problems using the tool. The Help Menu can be accessed through the **Output Data** tab on the main menu.

Urban an	d Suburban Arterials	epartment c tput Data	of Transportation
	Show Detailed Analysis	Show Calculations	Print Preview
	Export Data	Edit/Change Analysis	Help
			Exit HSM Tool

By pressing the **Help** button, the user can download the IDOT HSM Tool Users Manual, access the different predictive methods instructions worksheets, and connect via hyperlink to the official HSM website. A screen capture of the help menu is shown below.

Help	X
HSM User's Manual	Download User's Manual
Show Instructions	Rural Two-lane Two-way Roads
	Rural Multilane highways
	Urban and Suburban Arterials
Additional Resource	Go To HSM Official Website
	Finish

The instruction tabs provide information about tab naming conventions, facility types, and AADT thresholds, as well as a legend explaining the different color coded cells.

Tabs naming convention:

Worksheet Name	Contents
UrbArt_0_Instructions	Current worksheet displaying overview, summary of spreadsheet worksheets, and description of color coding included in the worksheets.
UrbArt_1_Construction	Data in this worksheet has been used to help define the pull-down options in the analysis worksheets. There is no need for a user to work within this worksheet, but the worksheet should be retained so that the other worksheets can continue to use the options included in this sheet.
UrbArt_2_Seg 1	Analysis for the urban and suburban arterial segment

Facilities AADT thresholds:

	Urban and Suburban Arterials					
Segm	ent Type	AADT		Intersection type	AADT major	AADT minor
	2U	0 - 32,600		3ST	0 - 45,700	0 - 9,300
	3T	0 - 32,900		4ST	0 - 46,800	0 - 5,900
	4U	0 - 40,100		3SG	0 - 58,100	0 - 16,400
	4D	0 - 66,000		4SG	0 - 67,700	0 - 33,400
	5T	0 - 53,800				

Color coding scheme details in the worksheets:

Color Used	Type of Information Required from User
	Required input information as identified in the HSM.
	Input data required from the user but restricted to options provided in pull-down boxes.
	Optional input information that can be used
	to supplement the analysis if this
	information is available. This optional input
	information is reserved for locally-derived
	crash information. If the analyst elects to
	use this option so as to improve analysis
	for local crash distribution trends, each of
	the Tables with the locally- derived input
	also include a pull-down box where the
	analyst should indicate he or she is using
	locally derive crash information. The
	worksheets will then use the local values
	Instead of the HSIVI default values.

Press Finish to close the Help Menu.

Appendix A Tab Naming Definition – All Modules

A-1 Rural Two-Lane, Two-Way Roads

Worksheet Name	Contents
TLR_0_Instructions	Current worksheet displaying overview, summary of spreadsheet worksheets, predictive method AADT thresholds, and description of color coding included in the worksheets.
TLR_1_Construction	Data in this worksheet has been used to help define the pull-down options in the analysis worksheets. There is no need for the user to work within this worksheet, but the worksheet should be retained so that the other worksheets can continue to use the options included in this sheet.
TLR_2_Seg 1	Analysis for the rural 2-lane segments that uses lookup tables from exhibits included in the worksheet named Segment Tables. The associated HSM worksheets are 1A, 1B, 1C, 1D, and 1E.
TLR_3_Seg Tables	Includes segment tables used for analysis of HSM- provided crash trends as well as locally-derived crash information. These are HSM Tables 10-3, 10-4, and 10-12. This worksheet also includes tables used for CMF calculations, and HSM Tables 10-8, 10-9, and 10-10.
TLR_4_Int 1	Analysis for the rural 2-lane intersections that uses lookup tables from exhibits included in the worksheet named Intersection Tables. The associated HSM worksheets are 2A, 2B, 2C, 2D, and 2E.
TLR_5_Int Tables	Includes intersection tables used for analysis of HSM-provided crash trends as well as locally-derived crash information. These are HSM Tables 10-5, 10-6, and 10-15. This worksheet also includes Tables 10-13 and 10-14, which are used for Crash Modification Factors (CMF) calculations.
TLR_6_Predicted Total	Predicted number of crashes summary sheet using results from the 2-lane segments as well as two-lane intersections worksheets. This analysis can be performed if no historical crash data are available within the study limits. The associated HSM worksheets are 3A and 3B.
TLR_7_Site EB Total	Analysis for site-specific EB analysis using results from the rural two- lane segment as well as rural two-lane intersection worksheets. This analysis can be performed if the analyst knows the exact location of historic crashes within the study limits. The associated HSM worksheets are 4A and 4B.

Worksheet Name	Contents
TLR_8_Project EB Total	Analysis for project-specific EB analysis using results from the rural two-lane segment as well as rural two-lane intersection worksheets. This analysis can be performed if the analyst has historical crash data, but does not know the exact location within the project limits at which the crashes occurred. The associated HSM worksheets are 5A and 5B.
TLR_91_SiteEB_ExSum	Executive summary report for site-specific EB analysis. This report uses results from tab TLR_7_Site EB Total. This report is available when the user performs a site-specific EB multiyear analysis entering AADT for each year.
TLR_92_ProjEB_ExSum	Executive summary report for project-specific EB analysis. This report uses results from tab TLR_8_Project EB Total. This report is available when the user performs a project-specific EB multiyear analysis entering AADT for each year.
TLR_93_EB_ExSum_GF	Executive summary report for site-specific EB analysis. This report uses results from tab TLR_7_Site EB Total. This report is available when the user performs a site-specific EB multiyear analysis and applies a linear traffic growth factor.
TLR_94_Pred_ExSum_GF	Executive summary report for the predicted number of crashes method. This report uses results from tab TLR_6_Predicted Total. This report is available when users perform a predicted crash multiyear analysis and apply linear traffic growth factor.
TLR_95_ProjEB_ExSum_GF	Executive summary report for project-specific EB analysis. This report uses results from tab TLR_8_Project EB Total. This report is available when the user performs a project-specific EB multiyear analysis and applies linear traffic growth factor.

A-2 Rural Multilane Highways

Worksheet Name	Contents
MLR_0_Instructions	Current worksheet displaying overview, summary of spreadsheet worksheets, and description of color coding included in the worksheets.
MLR_1_Construction	Data in this worksheet has been used to help define the pull- down options in the analysis worksheets. There is no need for a user to work within this worksheet, but the worksheet should be retained so that the other worksheets can continue to use the options included in this sheet.
MLR_2_Rural Div MultiLn Seg 1	Analysis for the rural divided multilane segment analysis includes AADT specific Table 11-16. The associated HSM worksheets are 1A, 1B (a), 1C (a), 1D (a), and 1E.
MLR_3_Rural Und MultiLn Seg 1	Analysis for the rural undivided multilane segment analysis includes AADT specific Tables 11-11 and 11-12. The associated HSM worksheets are 1A, 1B (b), 1C (b), 1D (b), and 1E.
MLR_4_Seg Tables	Worksheet shows exhibits for use by the segment worksheets. These exhibits are independent and do not depend on input values. This worksheet includes exhibits that summarize crash information and can be modified for locally-derived conditions. These are Tables 11-4, 11-6, 11-15, and 11-19. Tables specific to CMFs are also included. The CMF tables in this worksheet are 11-13, 11-14, 11-17, and 11-18.
MLR_5_Rural MultiLn Int 1	Analysis for the rural multilane intersection analysis includes Tables 11-9 and 11-24. The associated HSM worksheets are 2A, 2B, 2C, 2D, and 2E.
MLR_6_Int Tables	Tables 11-9 and 11-24 are intersection exhibits for estimating crash distributions and can be modified for locally-derived conditions if this information is available.
MLR_7_Rural MultiLn Pred Total	Predicted number of crashes summary sheet using results from the rural divided and undivided segments as well as rural intersection multilane worksheets. This analysis can be performed if no historical crash data are available within the study limits. The associated HSM worksheets are 3A and 3B.
MLR_8_RuralMulti_Ln_Site_EB_Tot	Analysis for site-specific EB analysis using results from the rural divided and undivided segment as well as rural intersection multilane worksheets. This analysis can be performed if the analyst knows the exact location of historical crashes within the study limits. The associated HSM worksheets are 3A and 3B.

Worksheet Name	Contents
MLR_9_RuralMultiLn_Proj_EB_Tot	Analysis for project-specific EB analysis using results from the rural divided and undivided segment as well as rural intersection multilane worksheets. This analysis can be performed if the analyst has historical crash data, but does not know the exact location within the project limits at which the crashes occurred. The associated HSM worksheets are 4A and 4B.
MLR_101_SiteEB_ExSum	Executive summary report for site-specific EB analysis. This report uses results from tab MLR_8_RuralMulti_Ln_Site_EB_Tot. This report is available when the user performs a site-specific EB multiyear analysis, entering AADT for each year.
MLR_102_ProjEB_ExSum	Executive summary report for project-specific EB analysis. This report uses results from tab MLR_9_RuralMultiLn_Proj_EB_Tot. This report is available when the user performs a project-specific EB multiyear analysis, entering AADT for each year.
MLR_103_Pred_ExSum_GF	Executive summary report for the predicted number of crashes method. This report uses results from tab MLR_7_Rural MultiLn Pred Total. This report is available when the user performs predicted crash multiyear analysis and applies a linear traffic growth factor.
MLR_104_SiteEB_ExSum_GF	Executive summary report for site-specific EB analysis. This report uses results from tab MLR_8_RuralMulti_Ln_Site_EB_Tot. This report is available when the user performs a site-specific EB multiyear analysis and applies a linear traffic growth factor.
MLR_105_ProjEB_ExSum_GF	Executive summary report for project-specific EB analysis. This report uses results from tab MLR_9_RuralMultiLn_Proj_EB_Tot. This report is available when the user performs a project-specific EB multiyear analysis and applies a linear traffic growth factor.

A-3 Urban and Suburban Arterials

Worksheet Name	Contents
UrbArt_0_Instructions	Current worksheet displaying overview, summary of spreadsheet worksheets, and description of color coding included in the worksheets.
UrbArt_1_Construction	Data in this worksheet has been used to help define the pull-down options in the analysis worksheets. There is no need for a user to work within this worksheet, but the worksheet should be retained so that the other worksheets can continue to use the options included in this sheet.
UrbArt_2_Seg 1	Analysis for the urban and suburban arterial segment analysis. The associated HSM worksheets are 1A, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1I, 1J, 1K, and 1L.
UrbArt_3_Seg Tables	Tables used for the segment analysis. Includes Tables 12-3, 12-4, 12-5, 12-6, 12-7, 12-8, 12-9, 12-19, 12-20, 12-21, and 12-23.
UrbArt_4_Int 1	Analysis for the urban and suburban arterial intersection analysis. The associated worksheets are 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2I, 2J, 2K, and 2L. Worksheets specific to STOP control or traffic signals may be blank if they do not apply to the specific intersection type selected for analysis.
UrbArt_5_Int Tables	Tables used for the intersection analysis. Includes Tables 12-10, 12-11, 12-12, 12-13, 12-14, 12-24, 12-26, and 12-27.
UrbArt_6_Predicted Total	Predicted number of crashes summary sheet using results from the urban segments as well as urban intersections worksheets. This analysis can be performed if no historical crash data are available within the study limits. The associated HSM worksheets are 3A and 3B.
UrbArt_7_Site_EB_Total	Analysis for site-specific EB analysis using results from the urban segment and intersection worksheets. This analysis can be performed if the analyst knows the exact location of historical crashes within the study limits. The associated HSM worksheets are 4A, 4B, and 4C.
UrbArt_8_Proj_EB_Tot	Analysis for project-specific EB analysis using results from the rural divided and undivided segment as well as rural intersection multilane worksheets. This analysis can be performed if the analyst has historical crash data, but does not know the exact location within the project limits at which the crashes occurred. The associated HSM worksheets are 4A and 4B.

Worksheet Name	Contents
UrbArt_91_SiteEB_ExSum	Executive summary report for site-specific EB analysis. This report uses results from tab UrbArt_7_Site_EB_Total. This report is available when the user performs a site-specific EB multiyear analysis, entering AADT for each year.
UrbArt_92_ProjEB_ExSum	Executive summary report for project-specific EB analysis. This report uses results from tab UrbArt_8_Proj_EB_Tot. This report is available when the user performs a project-specific EB multiyear analysis, entering AADT for each year.
UrbArt_93_Pred_ExSum_GF	Executive summary report for the predicted number of crashes method. This report uses results from tab UrbArt_6_Predicted Total. This report is available when the user performs predicted crash multiyear analysis and applies a linear traffic growth factor.
UrbArt_94_SiteEB_ExSum_GF	Executive summary report for site-specific EB analysis. This report uses results from tab UrbArt_7_Site_EB_Total. This report is available when the user performs a site-specific EB multiyear analysis and applies a linear traffic growth factor.
UrbArt_95_ProjEB_ExSum_GF	Executive summary report for project-specific EB analysis. This report uses results from tab UrbArt_8_Proj_EB_Tot. This report is available when the user performs a project-specific EB multiyear analysis and applies a linear traffic growth factor.

Appendix B Troubleshooting Office 2003

I opened the file from the IDOT website, and tried to run the tool, but I am getting the error shown below. How can I fix it?



You must download the tool and save it to your computer prior to use. Download the tool and click the **Save** button.

File Down	iload	×
Do you v	want to open or save this file?	
	Name: 12142007_Appenix_D.xls Type: Microsoft Excel Worksheet, 1.04 MB From: www.dot.state.il.us Open Save Cancel	
🔽 Always	s ask before opening this type of file	
	While files from the Internet can be useful, some files can poten namn your computer. If you do not trust the source, do not open save this file. <u>What's the risk?</u>	tially or

Choose where you would like to save the tool. Name it appropriately.

Save As						? 🔀
Save in:	Desktop		~	O Ø	10]+
My Recent Documents Desktop My Documents	My Document	is Maces				
My Computer	File name:	12142007_Appenix_D.xls			~	Save
My Network	Save as type:	Microsoft Excel Worksheet			~	Cancel

After the download is completed, click **Open**, and the tool is ready to use.

Download complete						
Dowr Saved: 12142007_Apper	nload Complete nix_D.xls from www.dot.state.il.us					
Downloaded: 1.04 MB in 5 sec Download to: C:\Docume\12142007_Appenix_D.xls Transfer rate: 214 KB/Sec Close this dialog box when download completes Open Open Folder Close						

When I opened the tool I clicked on Disable Macros, and the tool doesn't work.

Close the tool without saving changes and reopen it. Make sure to enable macros.

I accidentally saved the tool with the input data for my project inside. Is there a way to obtain the original tool without all the changes I made?

Yes. Go back to IDOT website (<u>http://www.dot.il.gov/illinoisshsp/hsip.html</u>) and download and save the tool again on your computer. If you want to save the information you input for a specific project, try using the Export Data option included in the tool under Output data.