

Louisiana's Evolution in the Science of Safety

Data Driven Safety Analysis

presented to

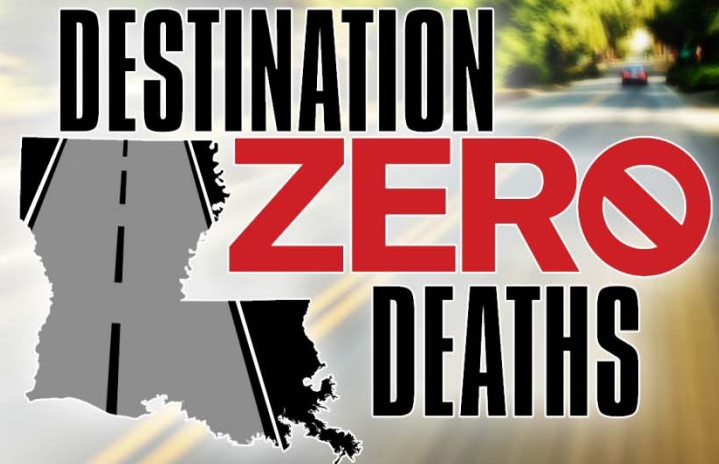
Traffic Engineer's Meeting

presented by

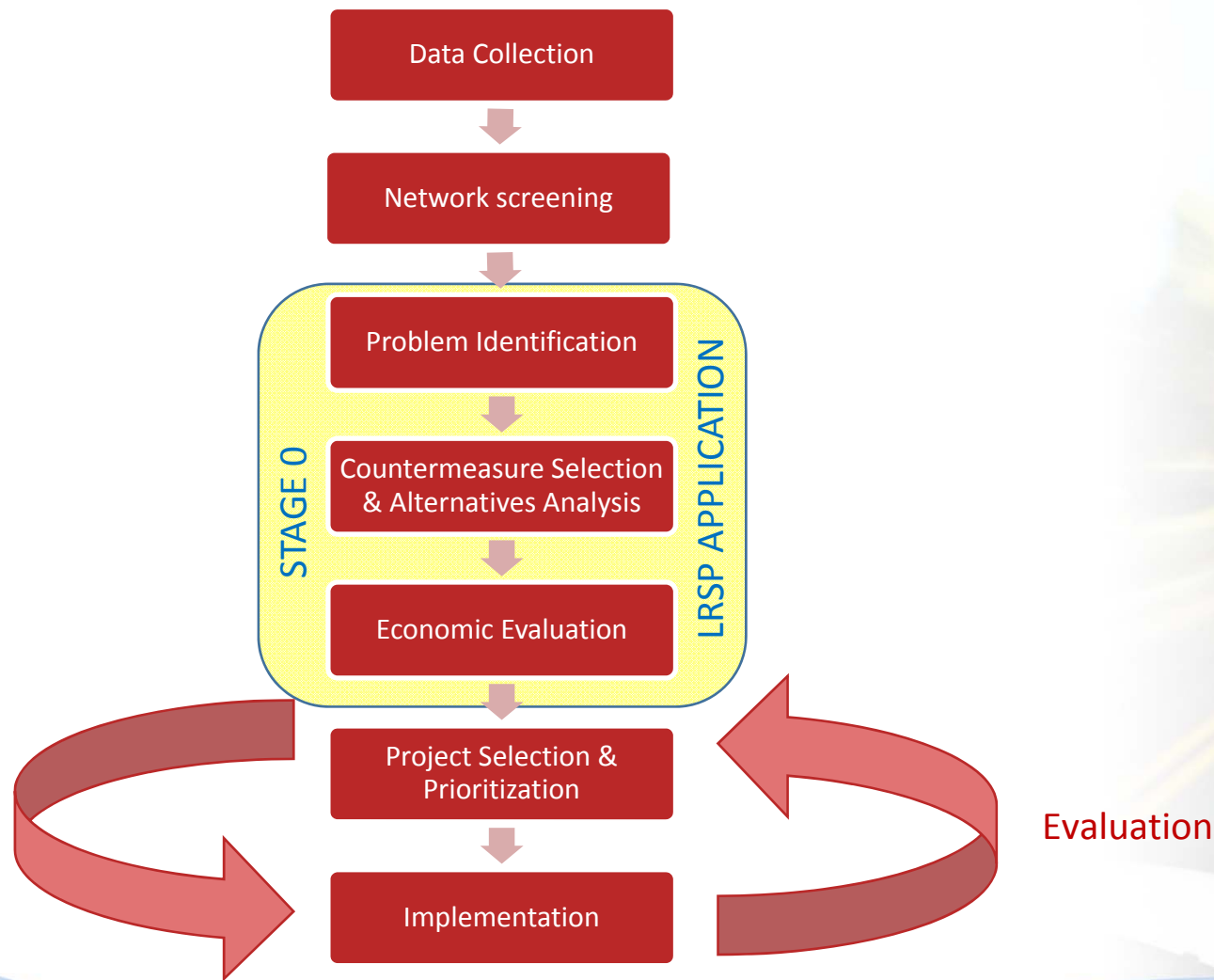
April Renard, P.E., PTOE

**Louisiana Department of Transportation and
Development - LADOTD**

July 25, 2016



Safety Management Process

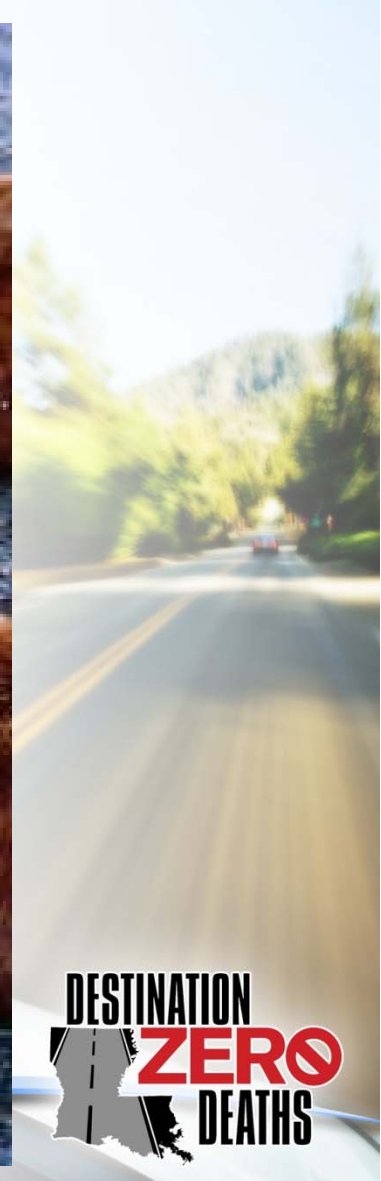


NETWORK SCREENING

A blurred photograph of a road at night, showing motion blur on the road surface and lights, suggesting a fast-moving vehicle.

**DESTINATION
ZERO
DEATHS**

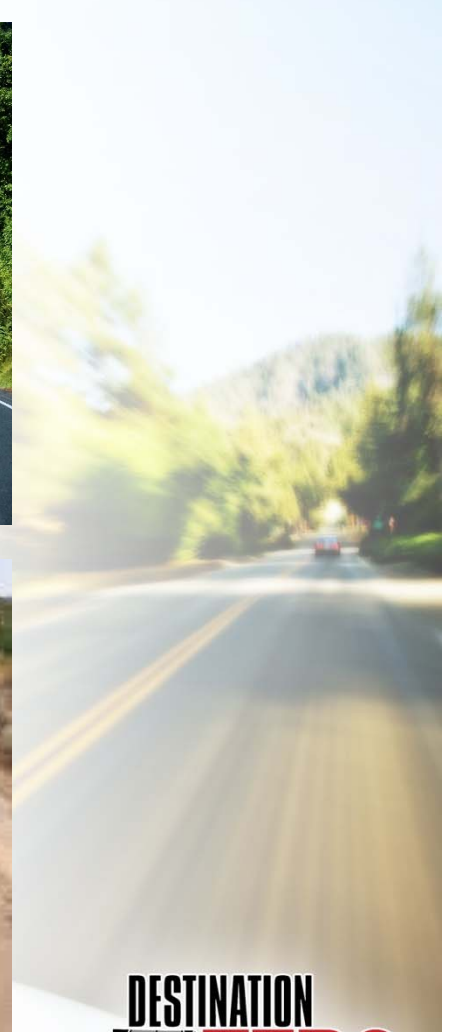
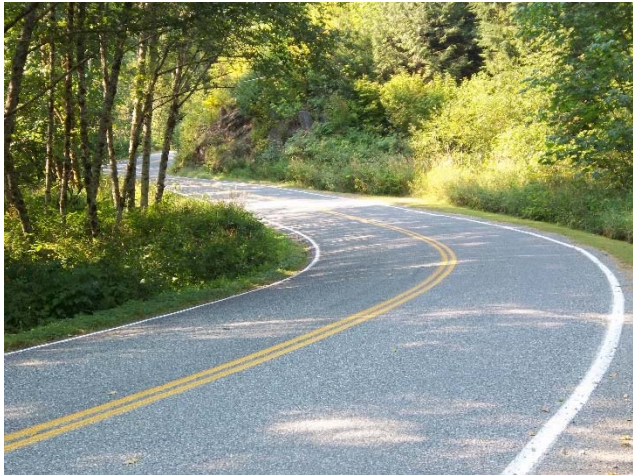
Network Screening



Network Screening



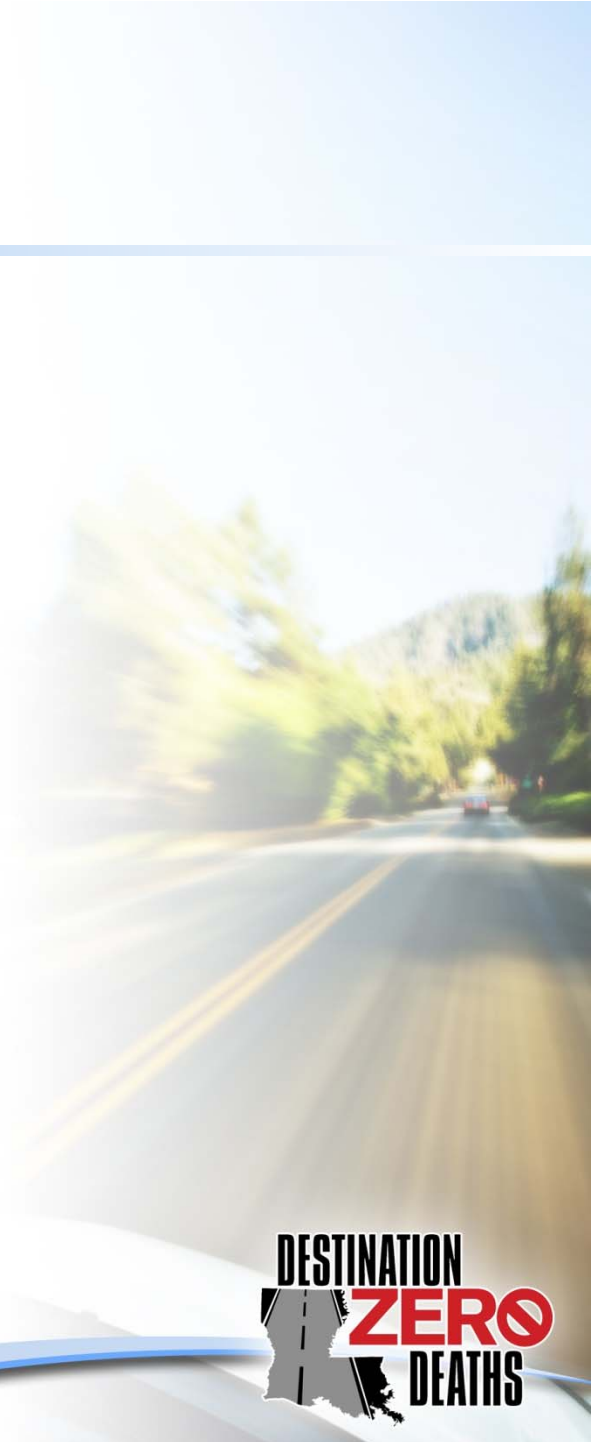
Network Screening



**DESTINATION
ZERO
DEATHS**

Network Screening Options

- Crash Frequency
- **Crash Rate**
- EPDO
- Relative Severity Index
- Critical Rate
- **Calibrated HSM Models (SafetyAnalyst)**
- **Regression Modeling (SPF/LOSS)**
- Excess Proportion of Specific Crash Types
- **Systemic Approach**



First, man invented fire, then the

Number-Rate Method

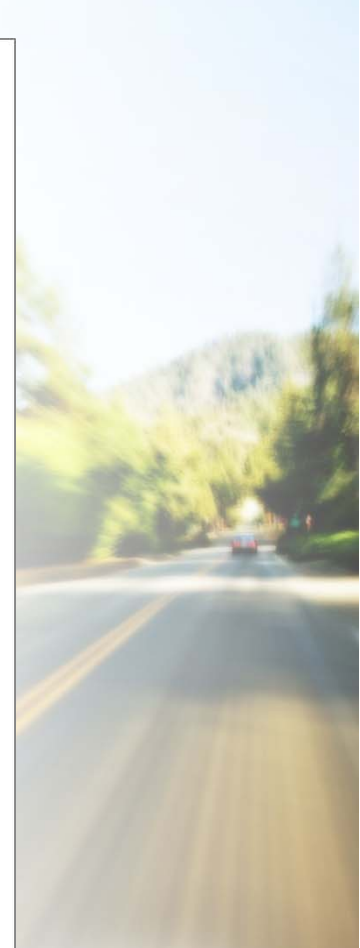
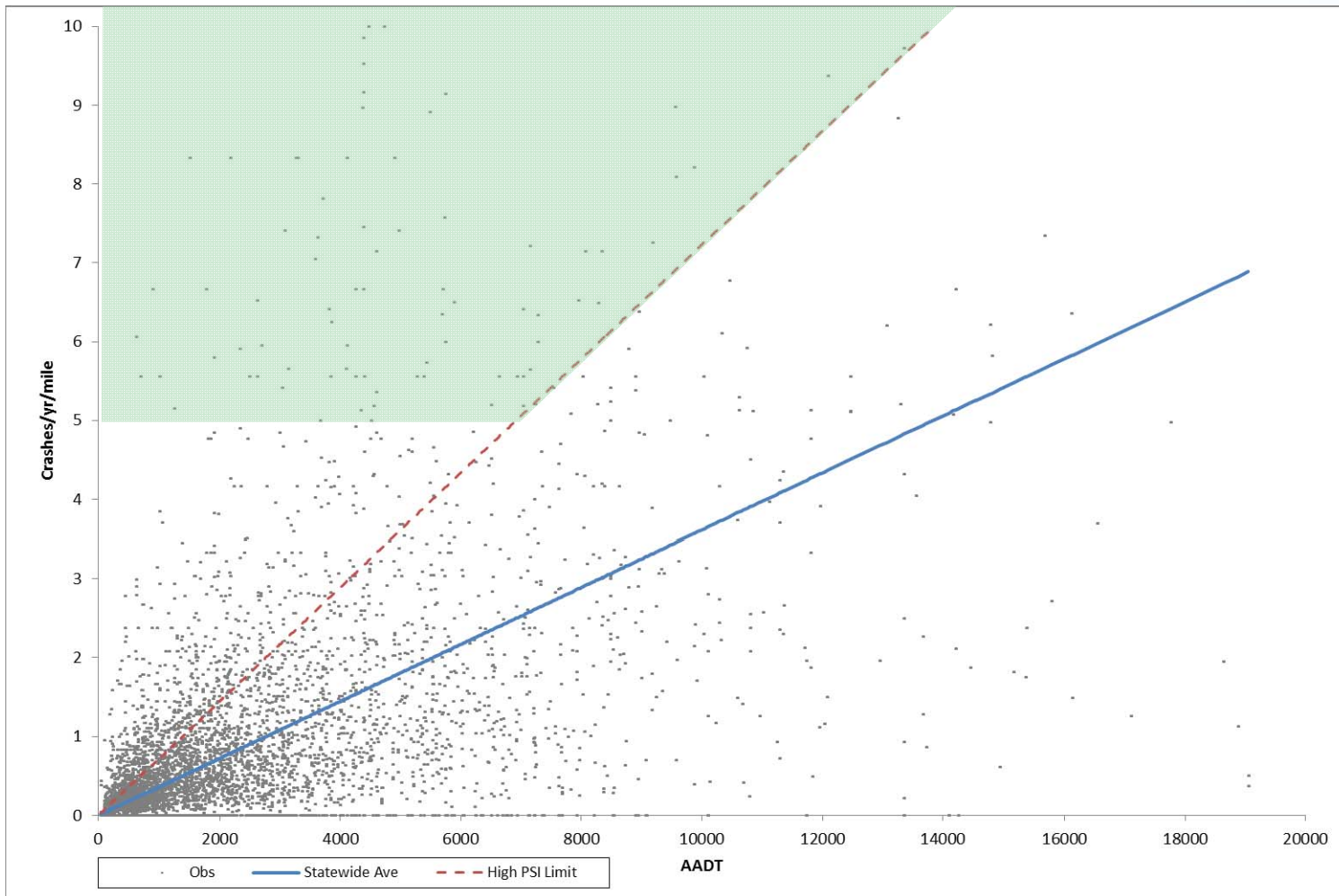
- Statewide averages by roadway classification based on:
 - AADT, Length and Crashes/yr

$$\text{Crash Rate} = \frac{\text{crashes}}{\text{yrs} * \text{Length} * \text{AADT}} * 10^6$$

Conditions for **High PSI** (Potential for Safety Improvements):

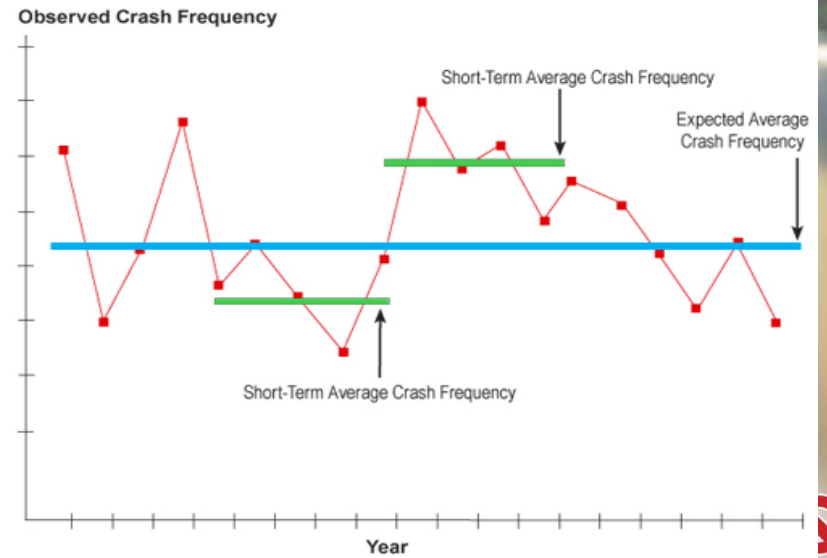
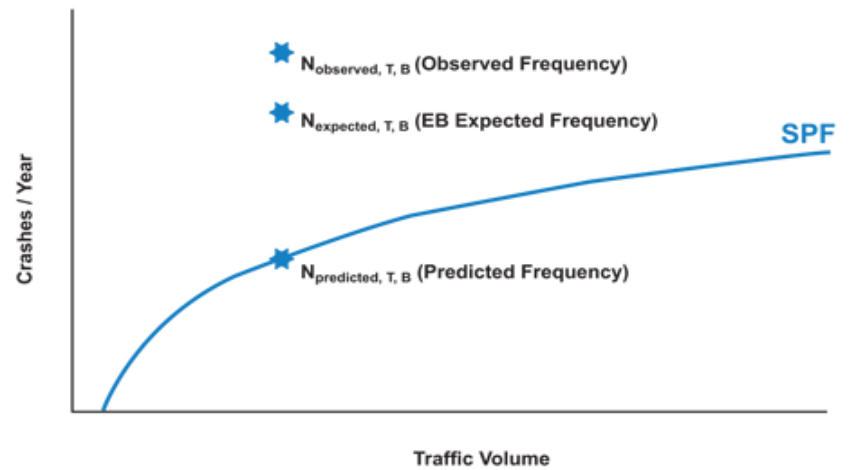
- at least 5 crashes on the section per year
- at least 5 crashes per mile on the section per year
- The crash rate must be at least twice the state average

Number-Rate Method

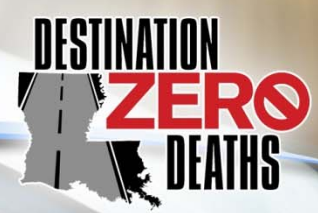
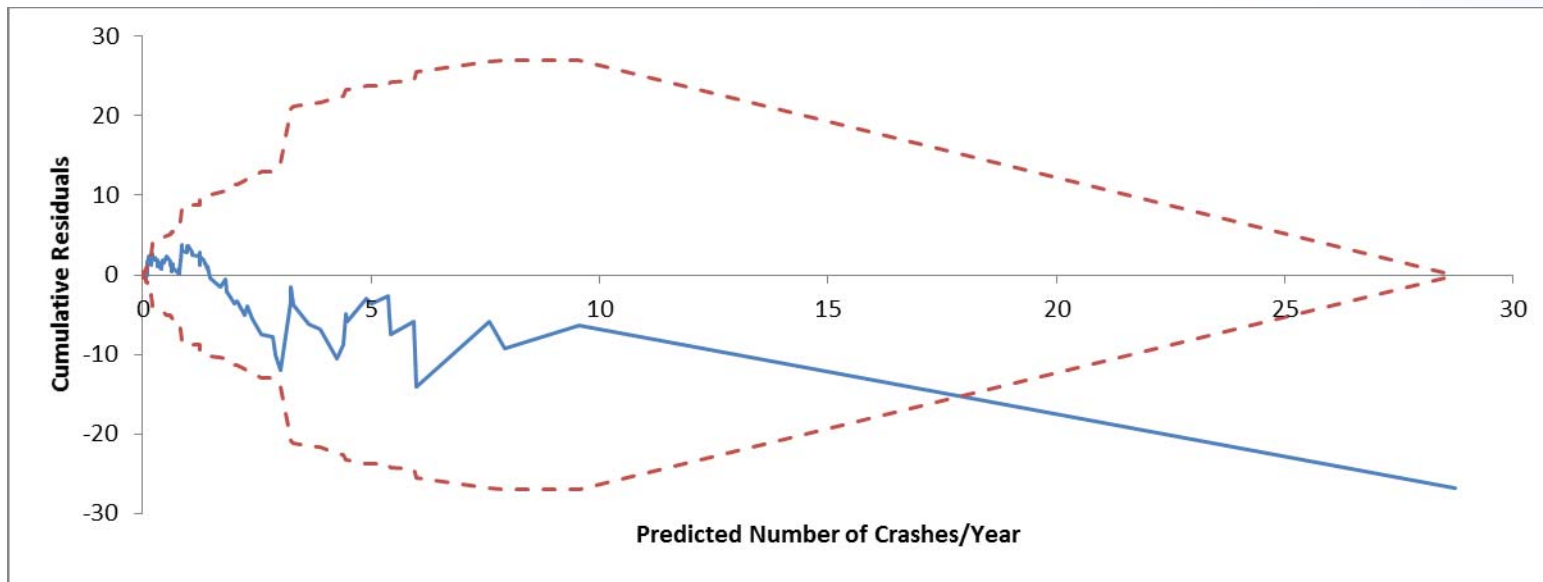


Fast forward to 2010...

HSM SPFs and Calibrated Models



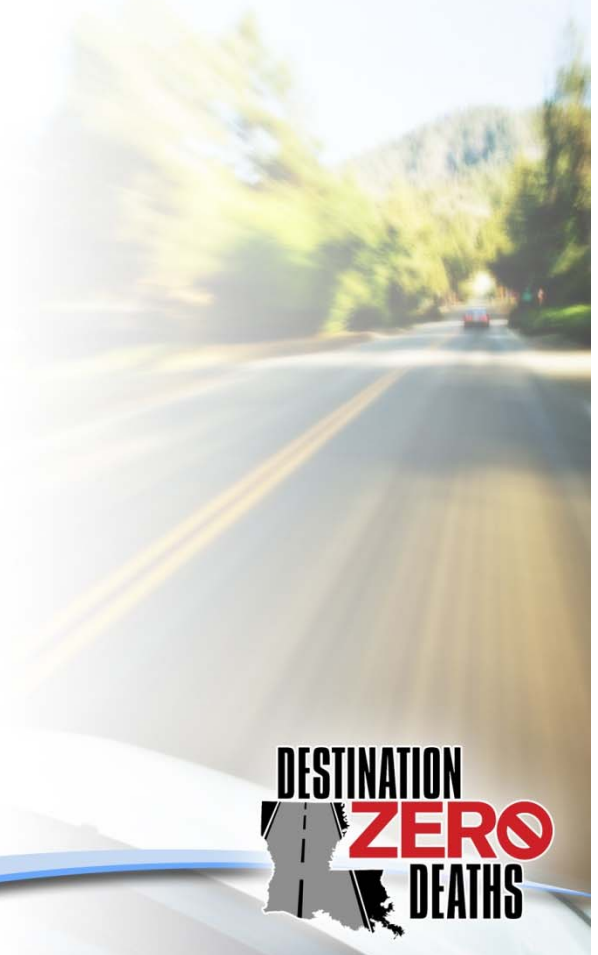
Raw HSM Model CURE (2U)



HSM SPFs and Calibrated Models

Data Element	Facility Type		
	Rural 2-lane	Rural 4-lane	Urban
Segment Length			
Average Annual Daily Traffic			
Lane Width			
Shoulder Type	*		
Shoulder Width			
Presence of Lighting	*	*	*
Driveway Density	*		
Presence of Center TWLTL			
Presence of Centerline Rumble Strip	*		
Roadside Hazard Rating	*		
Use of Automated Speed Enforcement	*	*	*
Sideslope		*	
Median Width			
Number of Through Traffic Lanes			
Presence of Median			
Number of Driveways by Land-Use Type			*
Low Speed vs. Intermediate or High Speed			*
Presence of On-Street Parking			*
Type of On-Street Parking			*
Roadside Fixed Object Density			*
	Not Applicable to this facility type		
	Data element available in Louisiana Roadway Database		
*	Data element gathered in additional data collection effort		

- Extensive data requirements



HSM SPFs and Calibrated Models

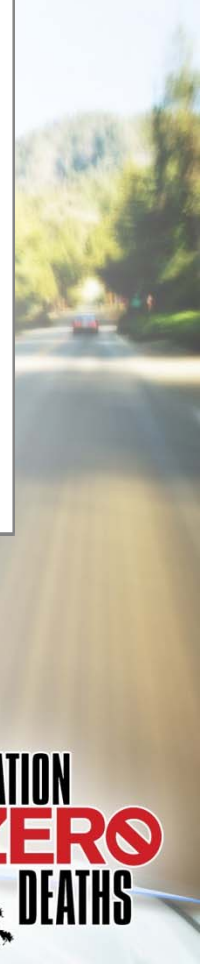
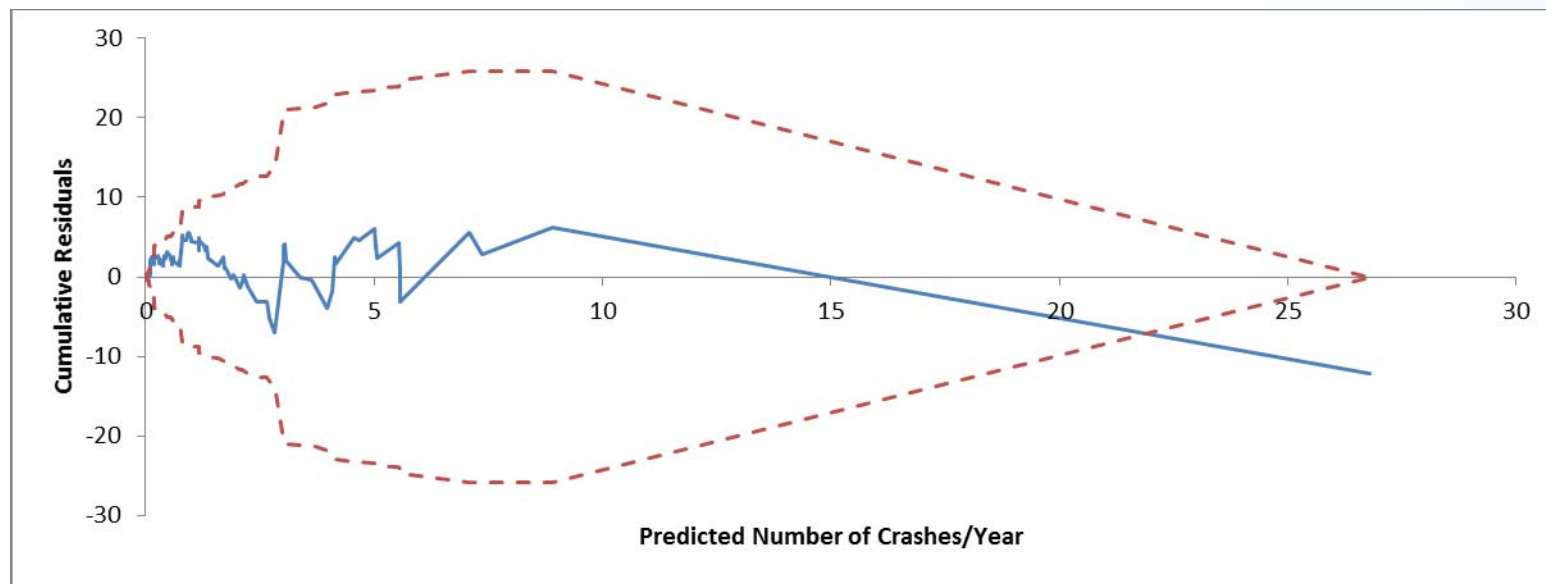
● NCHRP 20-07 User's Guide to Calibration

Facility Type	CF
Rural Two Lane	0.93
Rural Multilane Undivided	1.06
KABCO	1.06
KABC	0.59
KAB	0.36
Rural Multilane Divided	1.22
KABCO	1.22
KABC	0.63
KAB	0.27

Facility Type	Calibration Factors		
Urban Two Lane	2.50		
	M.V. n-dwy	Single Veh	M.V. dwy
KABCO	3.38	2.23	1.62
KABC	3.57	3.37	NA
PDO	3.31	1.86	NA
Urban Three Lane with TWLTL	4.53		
	M.V. n-dwy	Single Veh	M.V. dwy
KABCO	2.91	3.19	2.69
KABC	3.35	3.51	NA
PDO	2.76	3.07	NA
Urban Four Lane Undivided	3.18		
	M.V. n-dwy	Single Veh	M.V. dwy
KABCO	4.71	1.22	2.14
KABC	4.13	1.77	NA
PDO	4.96	1.04	NA
Urban Four Lane Divided	2.14		
	M.V. n-dwy	Single Veh	M.V. dwy
KABCO	2.51	2.06	1.12
KABC	2.49	2.64	NA
PDO	2.51	1.84	NA
Urban Five Lane with TWLTL	3.03		
	M.V. n-dwy	Single Veh	M.V. dwy
KABCO	3.45	0.64	3.55
KABC	3.82	0.97	NA
PDO	3.32	0.54	NA



Calibrated HSM Model CURE (2U)

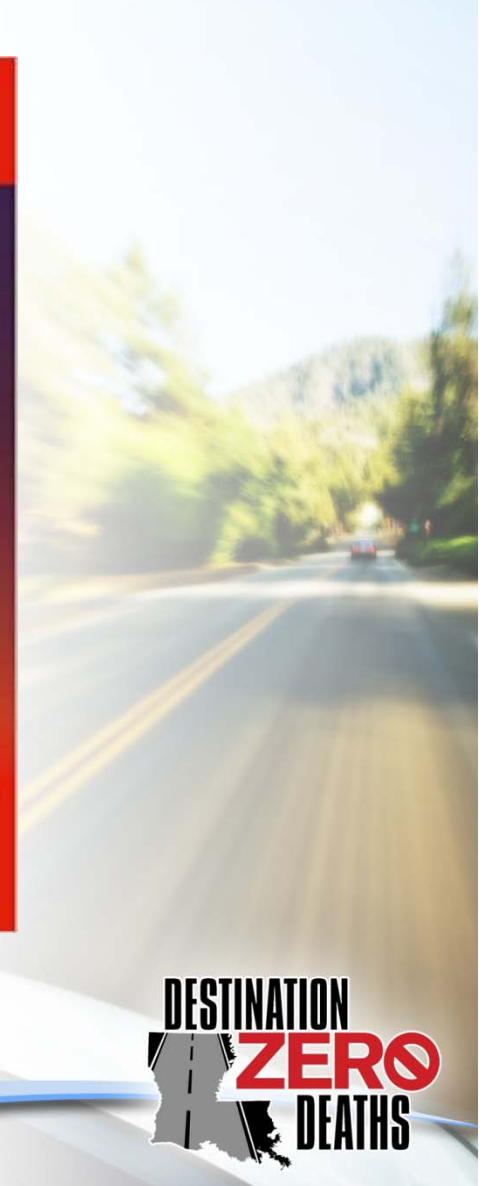
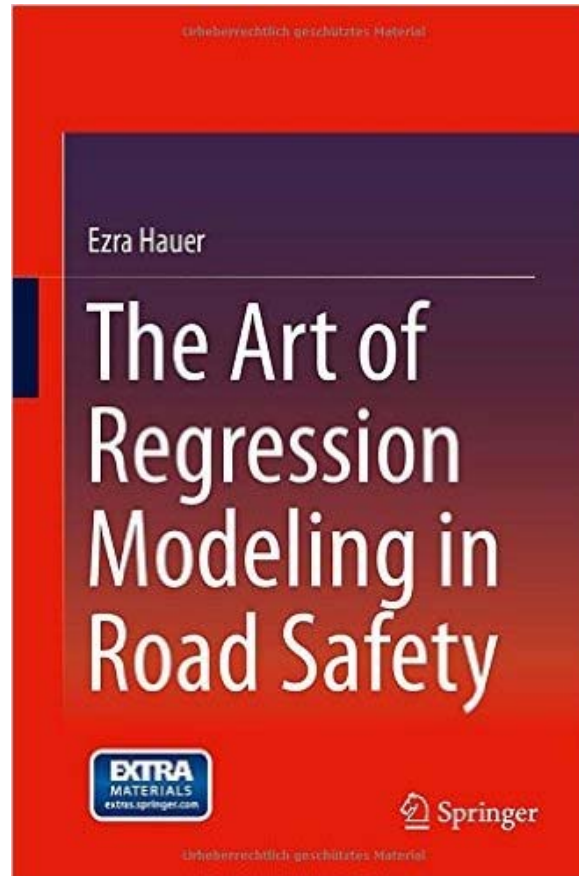


Calibration



Now...

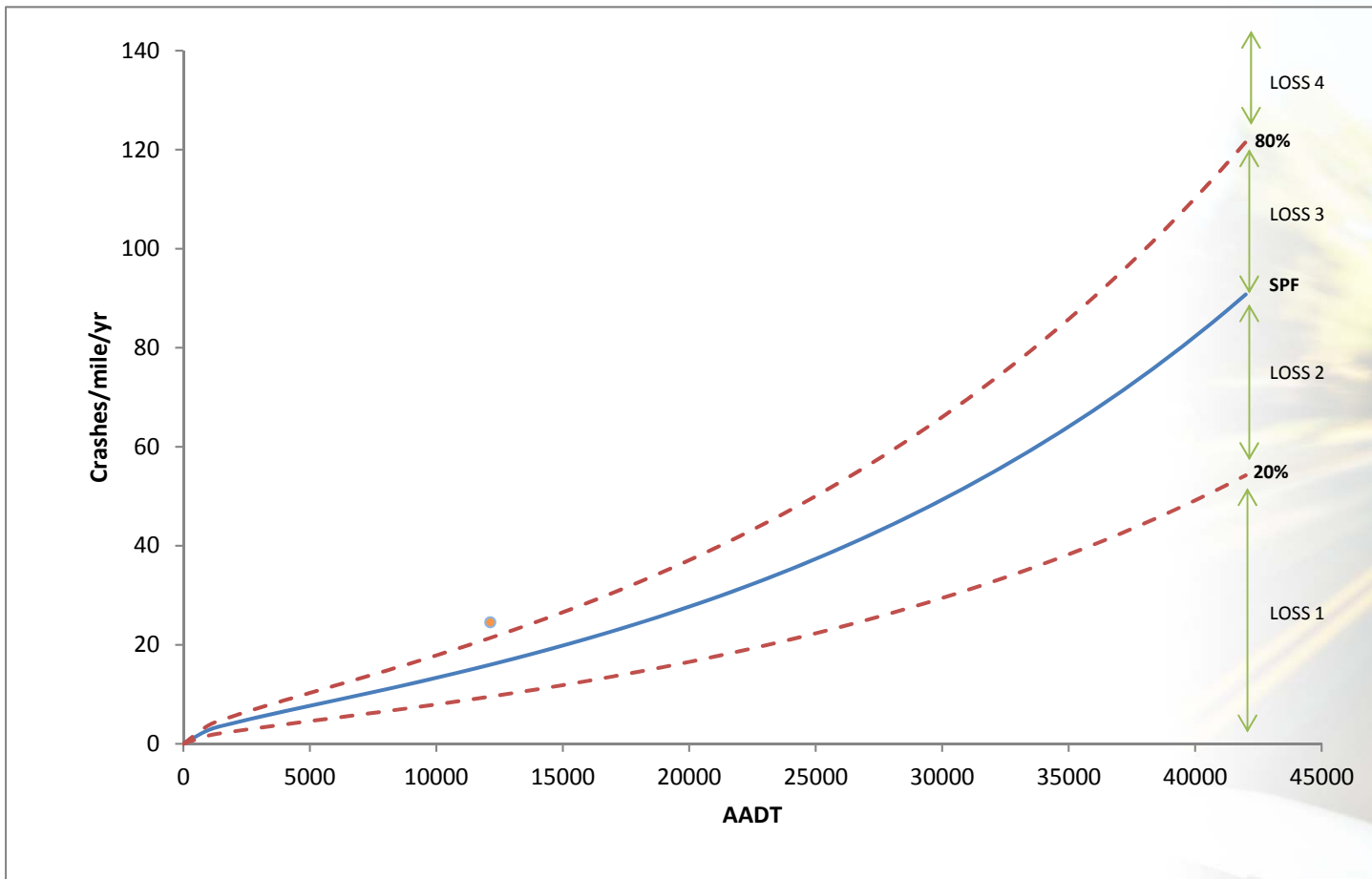
Regression Modeling



DESTINATION
ZERO
DEATHS


Regression Modeling

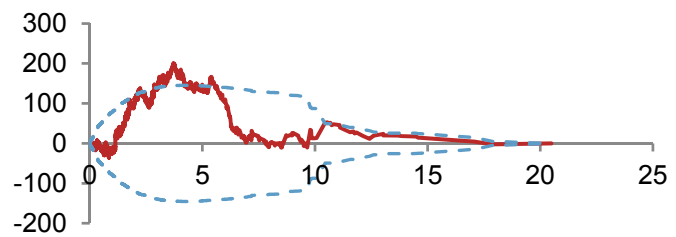
● Level of Service of Safety




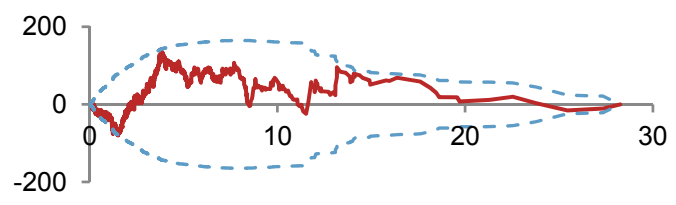
DESTINATION
ZERO
DEATHS


Regression Modeling

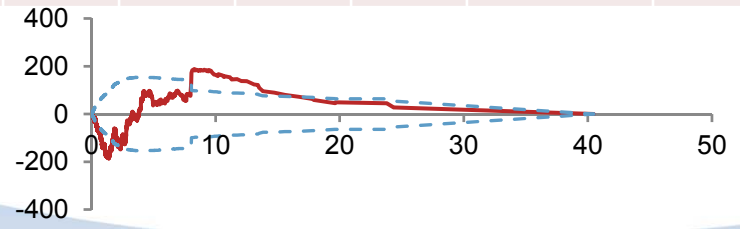
LA DOTD, Two-lane, Rural				β_0	β_1	β_2	
$\hat{E}\{\mu\} = L * \beta_0 * AADT^{\beta_1} * e^{\beta_2 * AADT}$				0.0034	0.711	0.000	0.786



LA DOTD, Two-lane, Rural		β_0	β_1	β_2	β_3	
$\hat{E}\{\mu\} = \beta_0 * L^{\beta_1} * AADT^{\beta_2} * (1 + \beta_3 * AADT)$		0.0577	0.940	-0.219	0.039	3.963

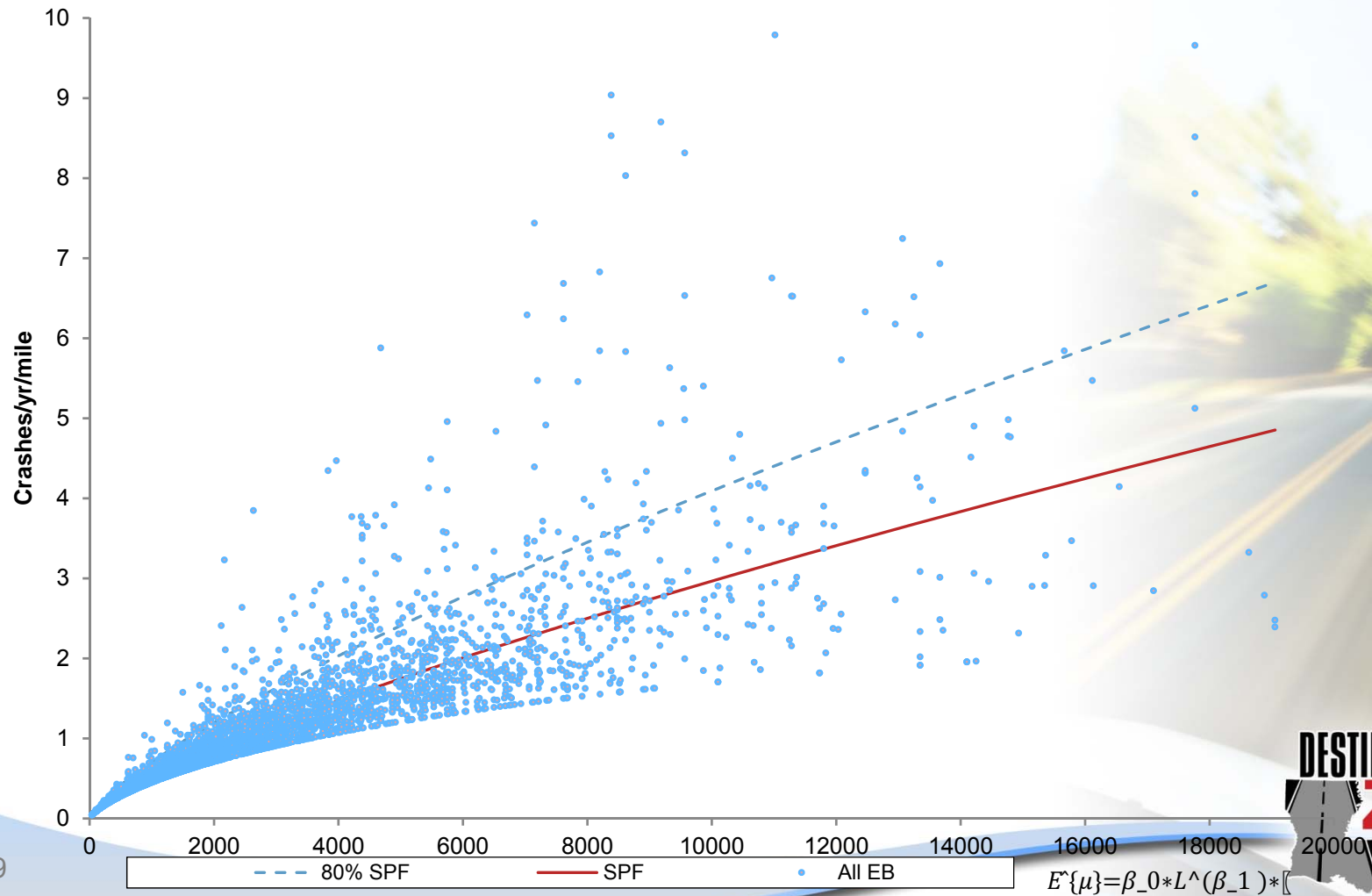


LA DOTD, Two-lane, Rural					β_0	β_1	β_2	β_3	
$\hat{E}\{\mu\} = \beta_0 * L^{\beta_1} * \frac{1}{1 + \beta_2 * AADT^{\beta_3}}$					549.4851	0.873	11116	-0.369	0.672



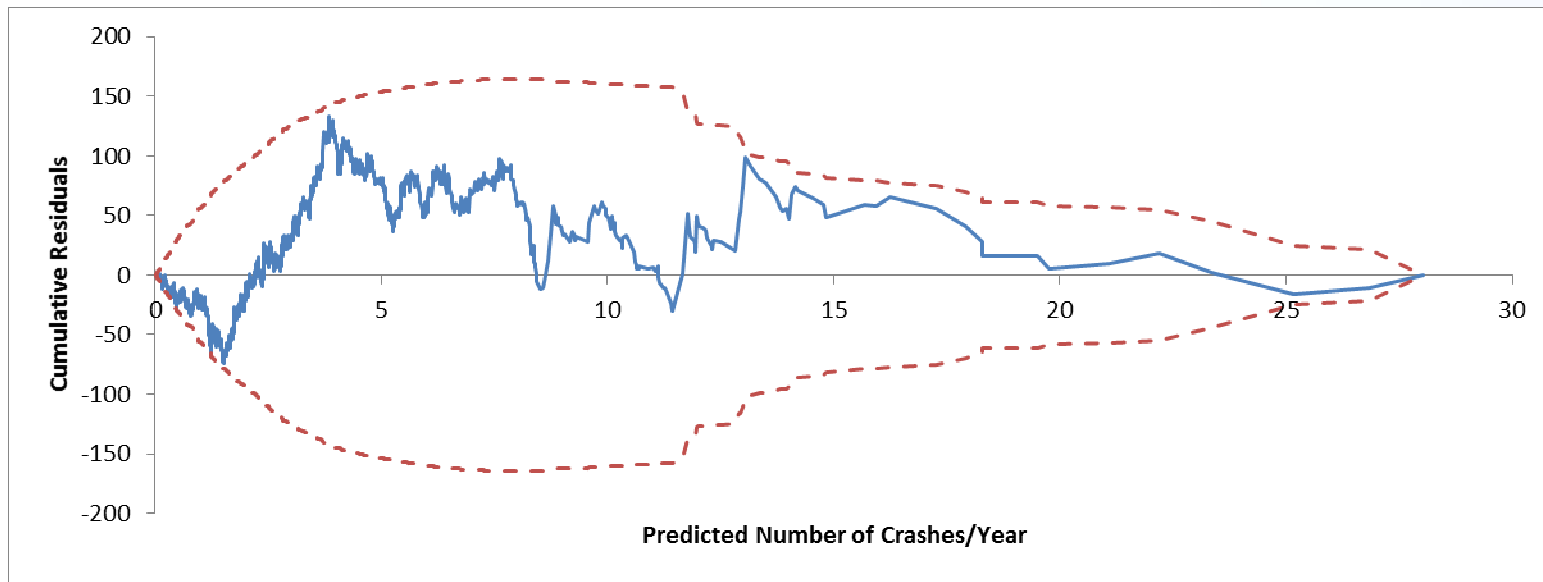
Regression Modeling

● KABCO SPF - Rural 2 Lane - Roadway Segments



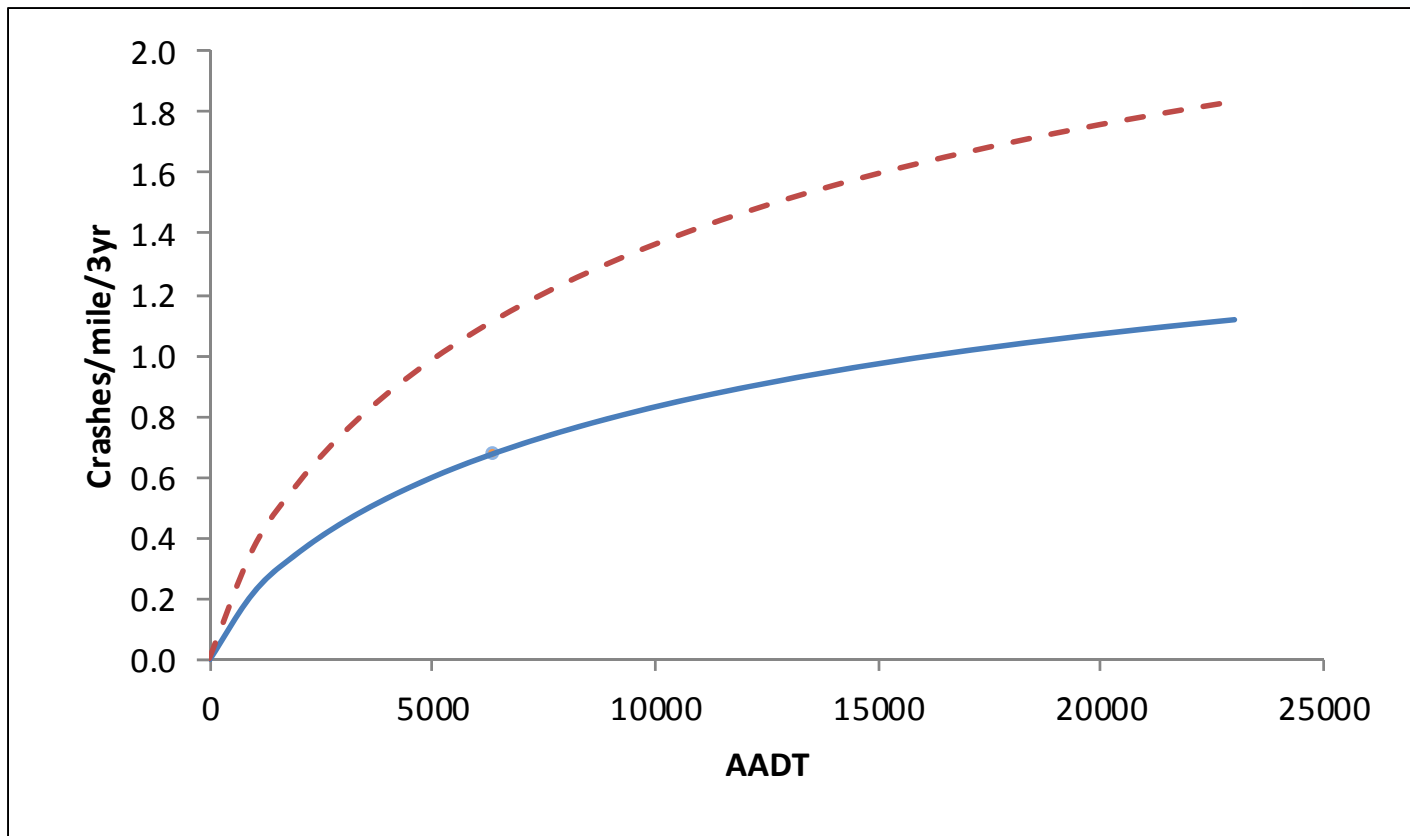
Regression Modeling

- KABCO SPF – Rural 2 lane – CURE plot



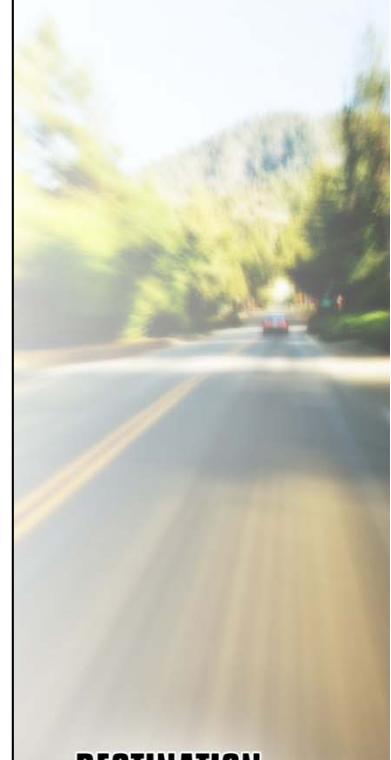
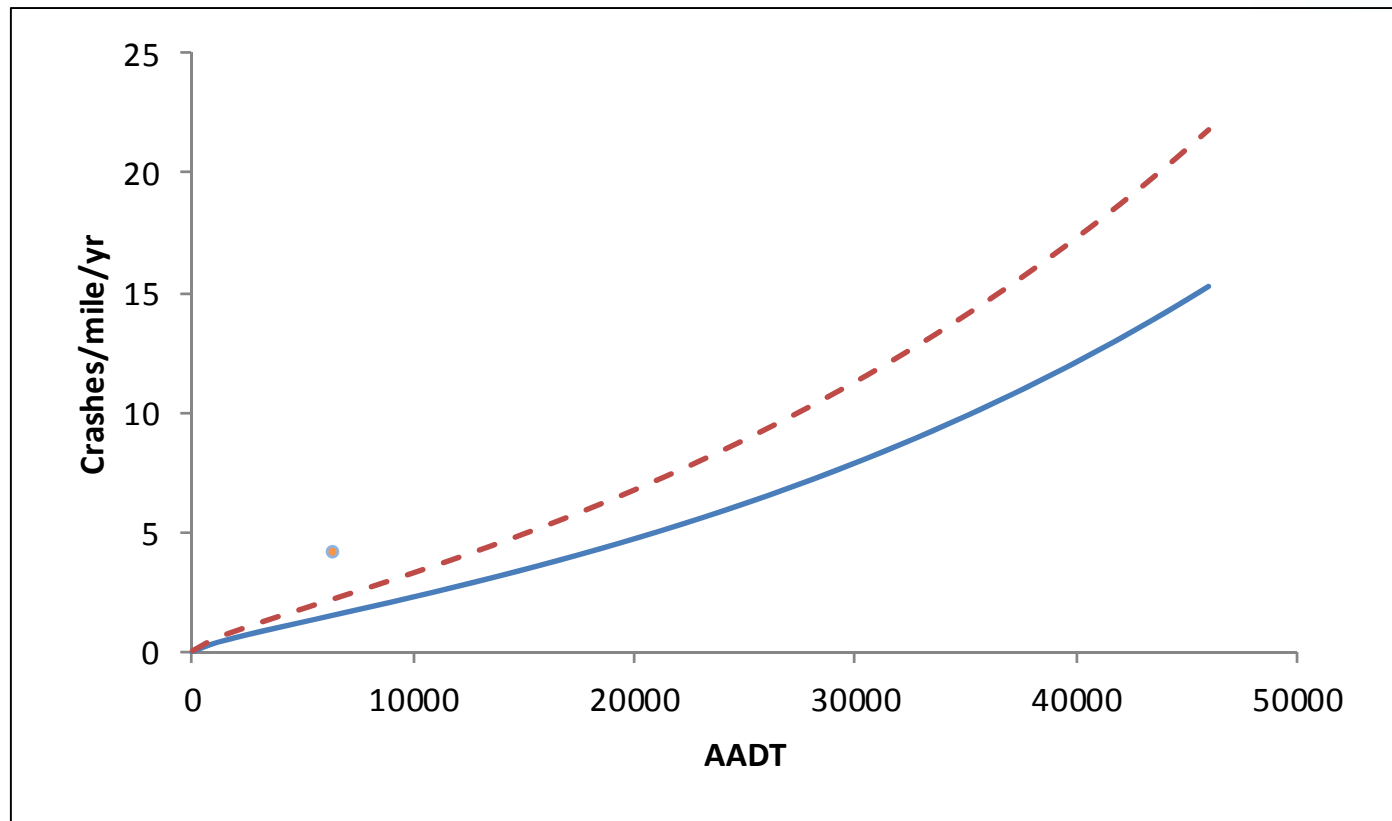
Regression Modeling

- KAB SPF - Rural 2 Lane - Roadway Segments



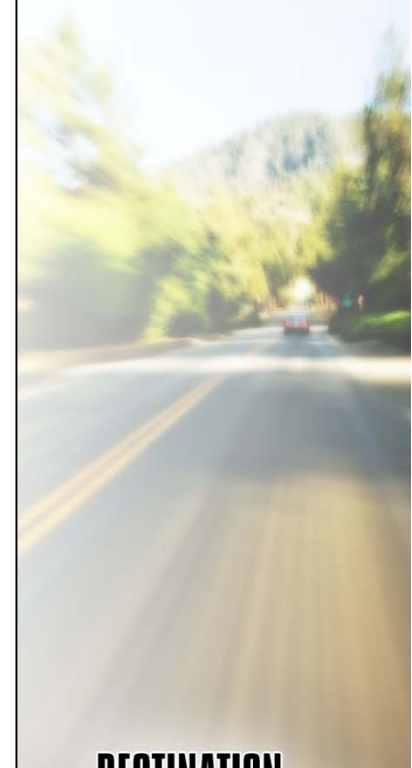
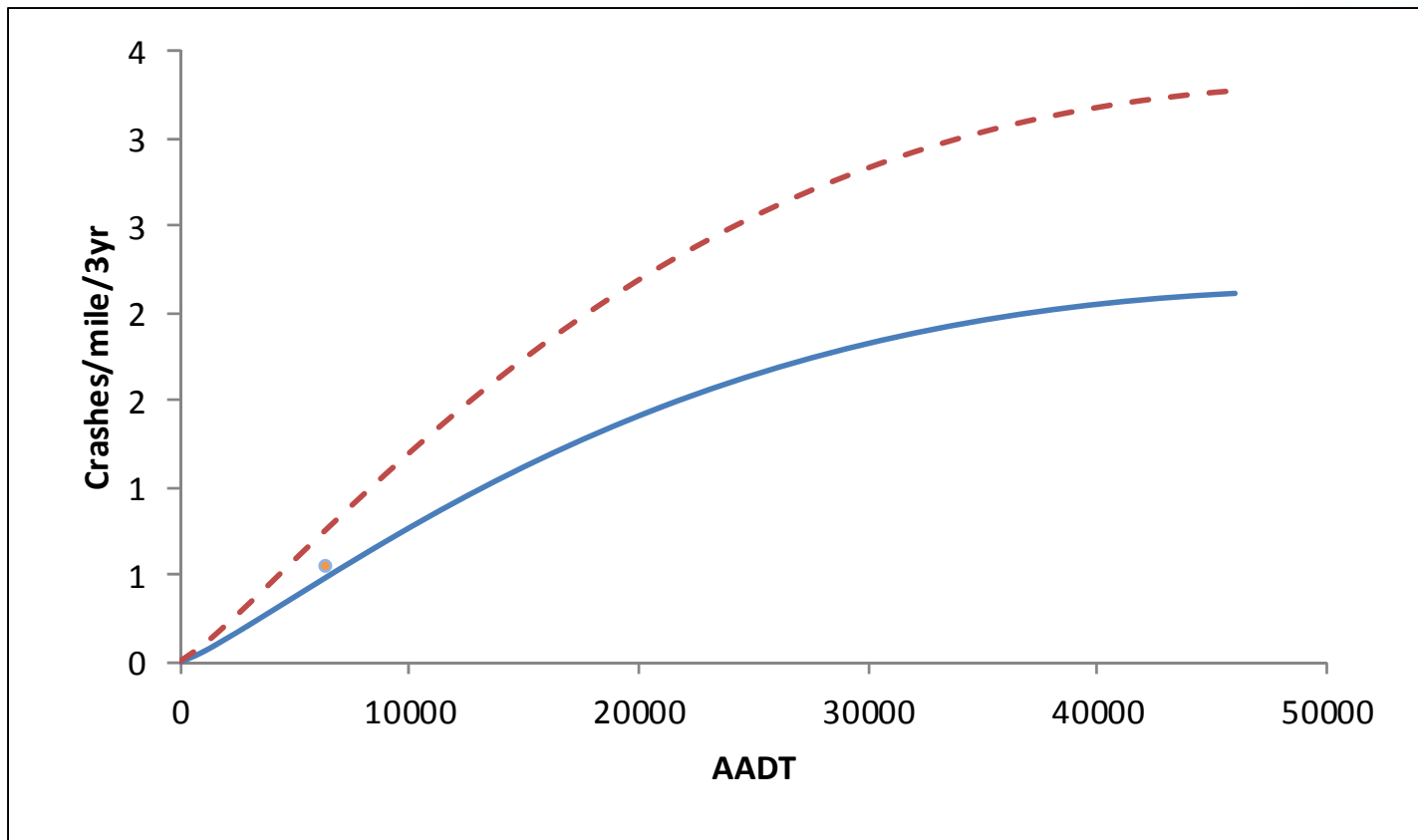
Regression Modeling

- KABCO SPF - Rural 4 Lane Divided - Roadway Segments



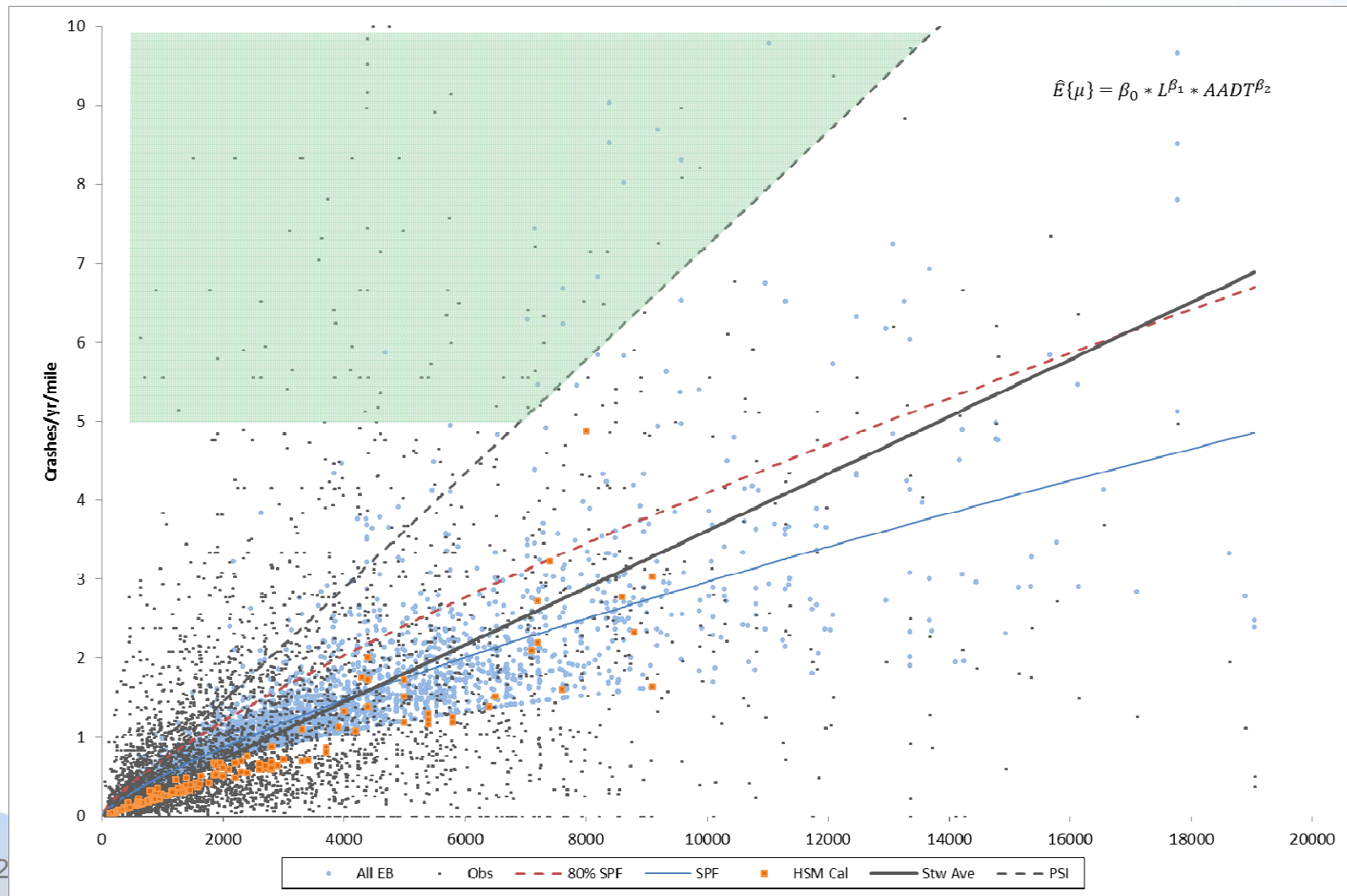
Regression Modeling

- KAB SPF - Rural 4 Lane Divided - Roadway Segments



Regression Modeling

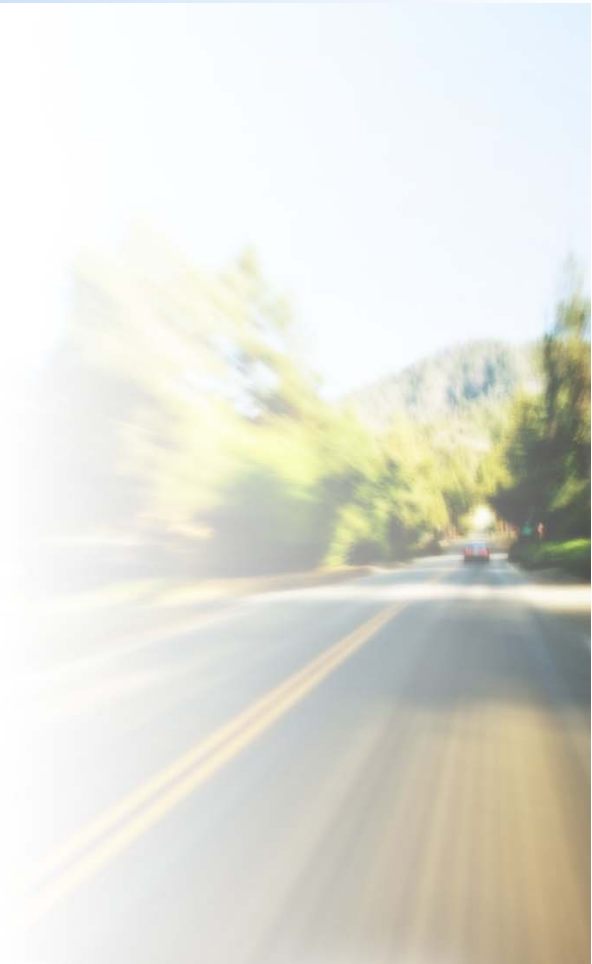
● Number-Rate, Calibrated HSM SPFs, LA Specific SPF



ATION
ZERO
DEATHS

Current Network Screening Methods

Highway Classification	Network Screening Method		
	Segments	Intersection	
		Non-signalized	Signalized
Rural Local	N-R	-	-
Rural 2-lane	LOSS	N-R	N-R
Rural 2-lane Cont Turn	LOSS	N-R	N-R
Rural 4-lane	LOSS	N-R	N-R
Rural 4-lane div	LOSS	N-R	N-R
Rural 4-lane Cont Turn	LOSS	N-R	N-R
Rural 4-lane Interstate	N-R	N-R	N-R
Rural 6-lane	LOSS	N-R	N-R
Rural 6-lane Interstate	N-R	N-R	N-R
Urban Local	N-R	-	-
Urban 2-lane	LOSS	N-R	N-R
Urban 2-lane Cont Turn	LOSS	N-R	N-R
Urban 4-lane	LOSS	N-R	N-R
Urban 4-lane div	LOSS	N-R	N-R
Urban 4-lane Cont Turn	LOSS	N-R	N-R
Urban 4-lane Interstate	N-R	N-R	N-R
Urban 6-lane	LOSS	N-R	N-R
Urban 6-lane Interstate	N-R	N-R	N-R



Abnormal/High PSI List

map	Rank within type	Type Loc	Highway Class	Control Sectio	Log M	Log Mile	Route	Distr	Parish Nu	Parish Name	Regional Coaliti	ADT	ADT	Cra
map	1	High PSI Section	Rural 2-lane	260-03	0	9.40	LA 22	62	32	Livingston	Capital	4100		
map	2	High PSI Section	Rural 2-lane	262-01	1.89	8.96	LA 16	62	32	Livingston	Capital	6000		
map	3	High PSI Section	Rural 2-lane	230-02	2.55	8.24	LA 75	61	24	Iberville	Capital	2800		
map	4	High PSI Section	Rural 2-lane	066-08	0	7.55	US 167	3	49	St. Landry	Acadiana	7600		
map	4	High PSI Section	Rural 2-lane	268-01	0	5.80	LA 447	62	32	Livingston	Capital	7000		
map	6	High PSI Section	Rural 2-lane	265-01	0.87	3.63	LA 44	61	3	Ascension	Capital	11333		
map	6	High PSI Section	Rural 2-lane	065-07	3.1	8.14	LA 20	61	47	St. James	South Central	4400		
map	8	High PSI Section	Rural 2-lane	397-05	0.59	2.43	LA 88	3	23	Iberia	Acadiana	4500		
map	8	High PSI Section	Rural 2-lane	268-01	5.8	6.32	LA 447	62	32	Livingston	Capital	7000		
map	10	High PSI Section	Rural 2-lane	272-02	4.52	9.13	LA 63	62	32	Livingston	Capital	6233		
map	10	High PSI Section	Rural 2-lane	004-03	1.05	4.90	LA 182	3	50	St. Martin	Acadiana	14300		
map	12	High PSI Section	Rural 2-lane	033-01	11.95	15.14	LA 115	8	5	Avoyelles	Central	6100		
map	12	High PSI Section	Rural 2-lane	073-03	1.19	8.80	LA 112	8	40	Rapides	Central	1903		
map	12	High PSI Section	Rural 2-lane	254-03	7.8	12.30	LA 37	61	17	East Baton Rouge	Capital	2600		
map	12	High PSI Section	Rural 2-lane	261-02	2.5	7.40	LA 42	62	32	Livingston	Capital	3233		
map	12	High PSI Section	Rural 2-lane	839-18	0	4.29	LA 977	61	39	Pointe Coupee	Capital	1600		
map	12	High PSI Section	Rural 2-lane	059-02	3.75	10.28	LA 25	62	52	St. Tammany	North Shore	11866		
map	18	High PSI Section	Rural 2-lane	045-30	0	4.59	LA 2	4	9	Caddo	Northwest	1910		
map	18	High PSI Section	Rural 2-lane	840-03	0	3.75	LA 1205	8	40	Rapides	Central	3466		
map	18	High PSI Section	Rural 2-lane	279-01	1.72	6.91	LA 437	62	52	St. Tammany	North Shore	9333		
map	18	High PSI Section	Rural 2-lane	276-05	6.44	9.36	LA 10	62	59	Washington	North Shore	4200		
map	18	High PSI Section	Rural 2-lane	260-07	1.04	4.94	LA 43	62	32	Livingston	Capital	5966		
map	18	High PSI Section	Rural 2-lane	260-05	3.19	5.44	LA 22	62	32	Livingston	Capital	6633		
map	18	High PSI Section	Rural 2-lane	257-01	2.26	3.53	LA 75	61	24	Iberville	Capital	3300		
map	18	High PSI Section	Rural 2-lane	216-01	0.69	7.02	LA 339	3	57	Vermilion	Acadiana	4233		
map	18	High PSI Section	Rural 2-lane	034-02	10.06	14.68	LA 6	8	43	Sabine	Central	5533		
map	18	High PSI Section	Rural 2-lane	238-02	0	3.21	LA 96	3	50	St. Martin	Acadiana	7033		
map	28	High PSI Section	Rural 2-lane	393-03	2	6.43	LA 343	3	28	Lafayette	Acadiana	4700		
map	28	High PSI Section	Rural 2-lane	260-02	7.68	8.77	LA 16	62	32	Livingston	Capital	11100		

Tableau Tool

