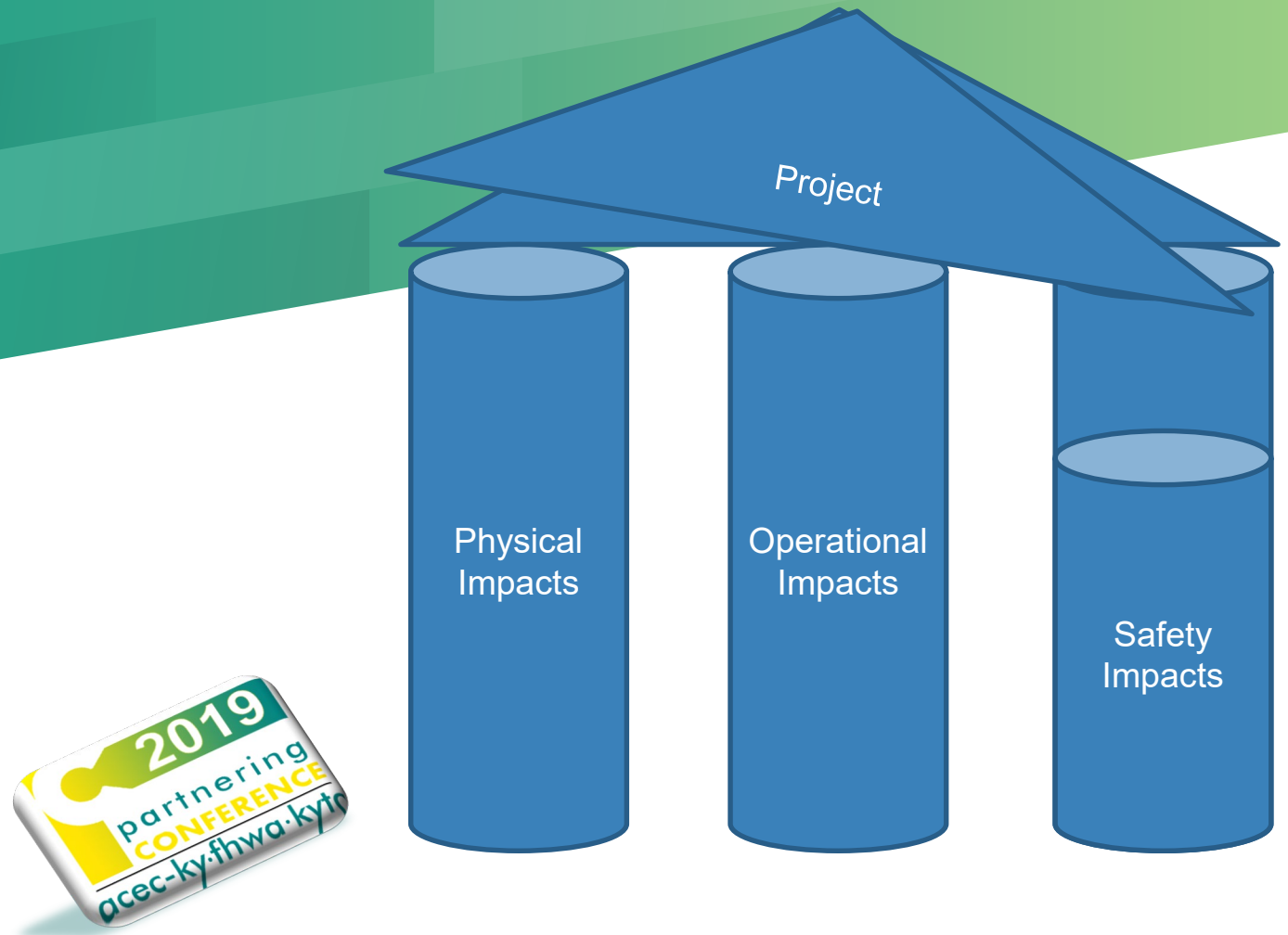
DDSA Tools and Training

Nathan Ridgway, PE

Why Data Driven Safety Analysis?

- A statistical based approach that aids and supports engineering judgment and decision making.
- Crashes can be quantified based on project decisions.

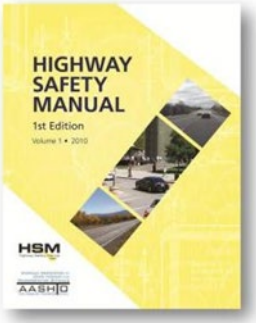

Project
Physical Impacts
Operational Impacts
Safety Impacts

What are the Tools?

- Crash Data – CDAT
- Predictive Analysis
  - HSM spreadsheets
  - ISATe
  - IHSDM
- Others
  - SPICE and CAP-X
  - Network Screening Tool

CRASH MODIFICATION FACTORS CLEARINGHOUSE

CDAT
Crash Data Access Tool



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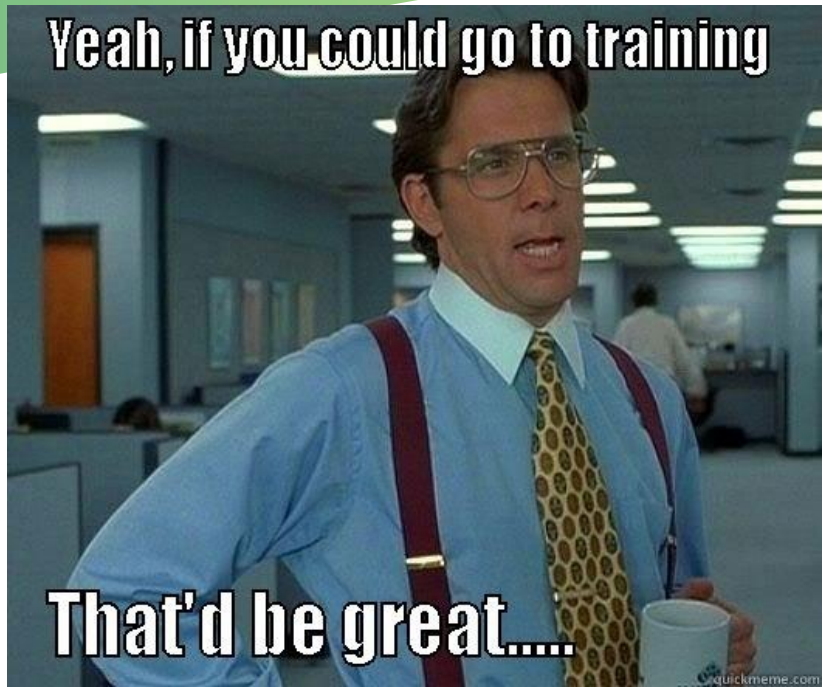
Training

- 3 Tiers
  - Beginning
  - Intermediate
  - Advanced



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Beginning Tier

- Suggested web based courses/webinars to allow the user to become familiar with the terms and calculations of the HSM
- NHI course offerings at zero cost

Beginning Tier

NHI Courses

- Highway Safety Manual Online Overview (NHI 380106)
- Safety Data and Analysis Fundamental Training for Data Analysts (NHI 380122A)
- Safety Data and Analysis Fundamentals Training for Data Collectors/Stewards (NHI 380122B)
- Safety Data and Analysis Fundamentals Training for Project and Program Managers (NHI 380122C)
- Safety Data and Analysis Fundamentals Training for Senior Managers and Safety Advocate (NHI 380122D)

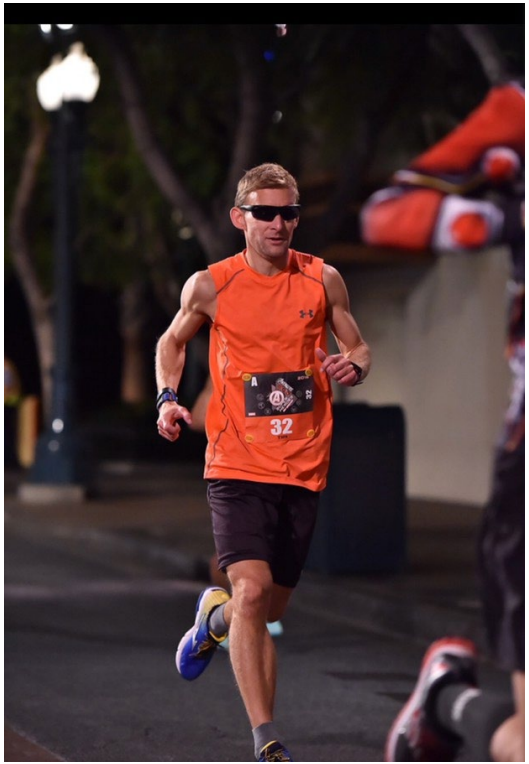
https://www.nhi.fhwa.dot.gov/course-search?tab=0

Intermediate Tier

- Predictive Methods
  - HSM spreadsheets
    - HSM Practioner's Guide for Geometric Design Features (NHI 380070
  - ISATe and IHSDM
    - Safety Analysis of Freeway Segments and Interchanges (NHI 380071)

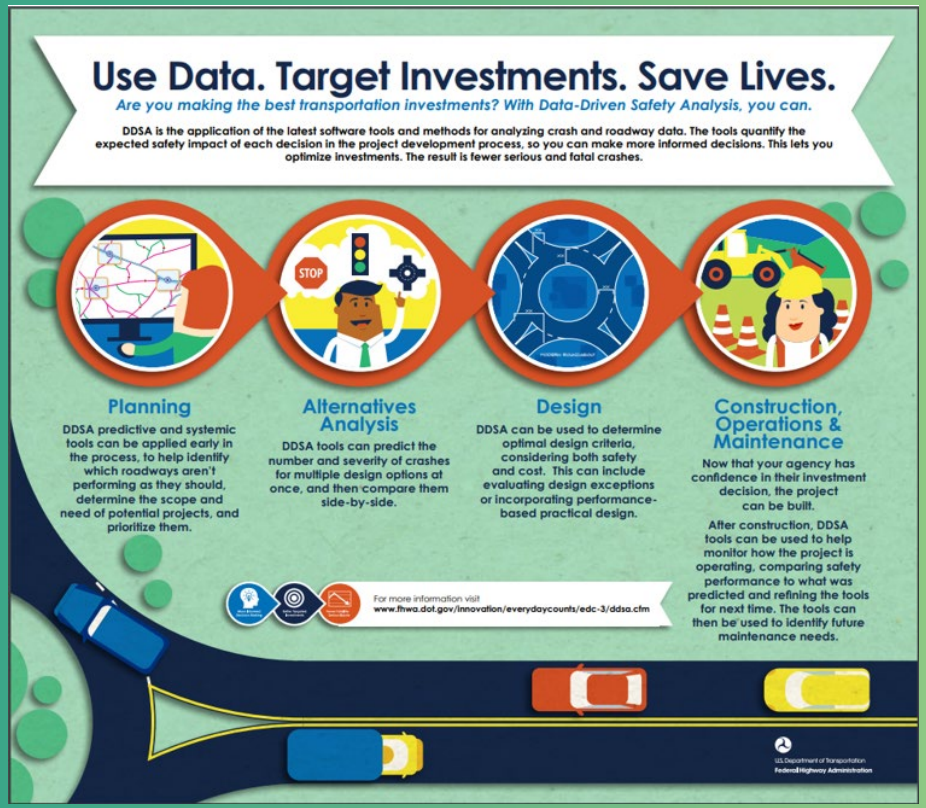
Advanced Tier

- KYTC developed courses to aid project managers and safety analyzers
  - Interpretation and Presentation of Predictive Method Results
  - Limitations of Safety Analysis



Next Steps

- Implementation Timeline
- Training Matrix
- Prequalifications



DDSA Web Resource

Jarrod Stanley

Research Coordinator – KYTC

jarrod.Stanley@ky.gov

https://business.kytc.ky.gov/work/DDSA/Pages/default.aspx

Data Driven Safety Analysis Home Crash Data DDSA Tools Consultant Information Resources Training

Search this site

Data Driven Safety Analysis

- Example Safety Studies
- KYTC Recommended Tasks & Hours - DRAFT
- Summary of SPFs and AFs
- SHIFT Safety

DDSA Contacts:
Planning
Highway Design
Training
Highway Safety Improvement Program
Traffic Operations
Training
Site Contents

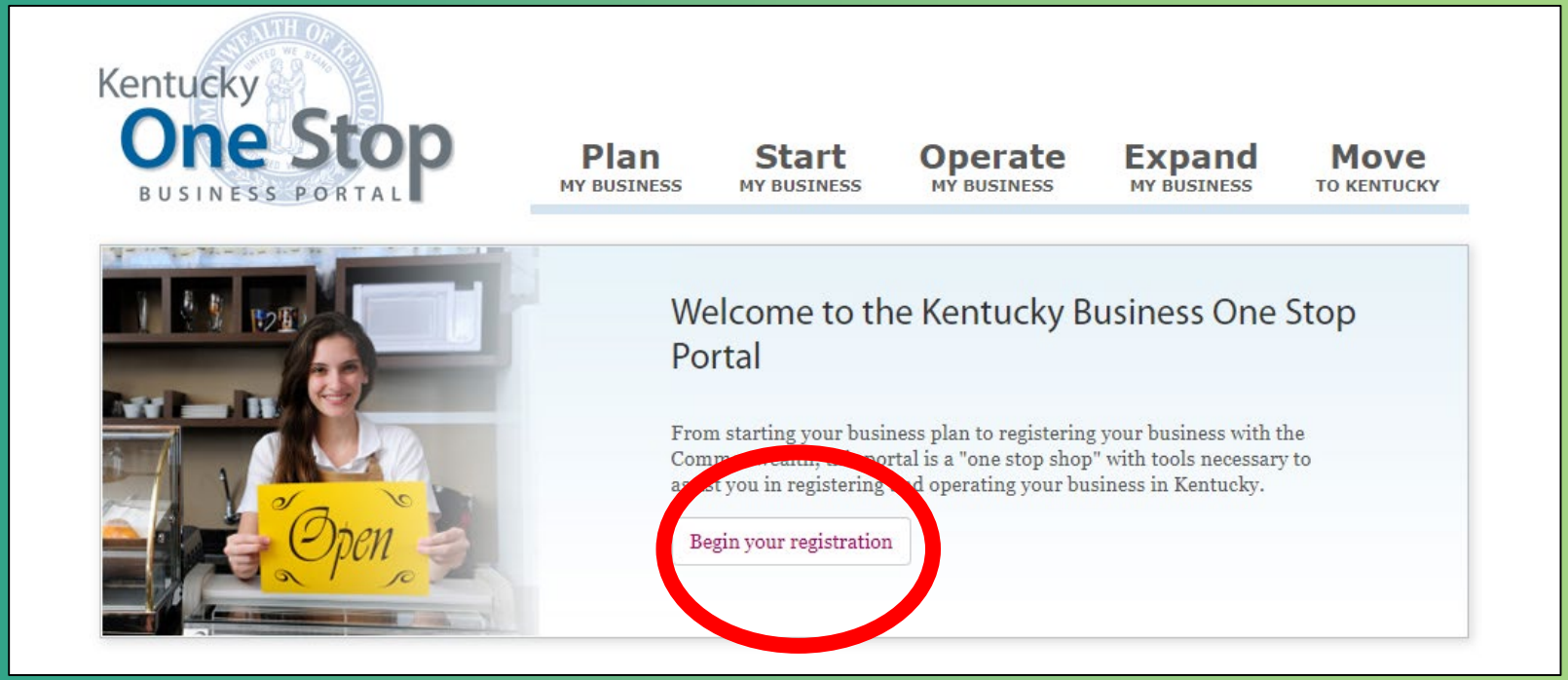
Why DDSA? A statistical based approach that aids and supports engineering judgement
How?

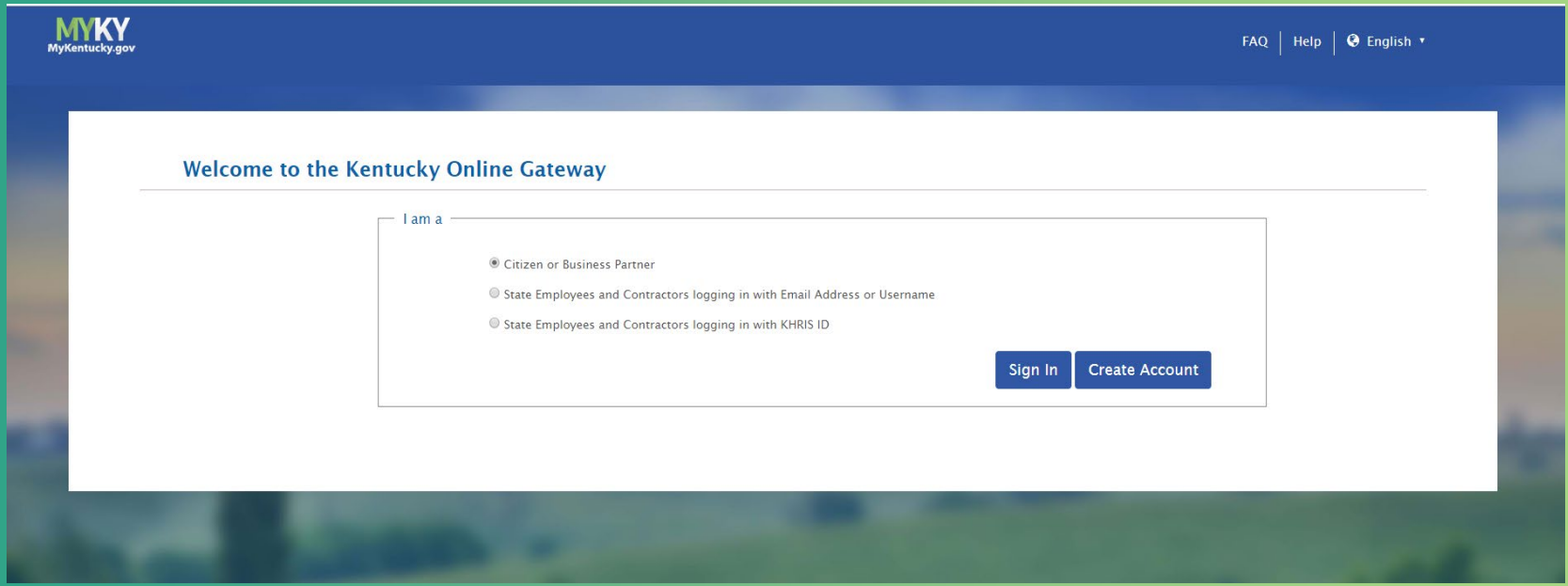
Sections

Home	Crash Data	DDSA Tools	Training	Consultant Information	Resources
What is DDSA? DDSA)	KSP (public site)	ISATe	WSDOT SR 509 PBPD Webinar	Example Safety Studies KYTC	Crash Costs
Implementation Plan & Schedule (Coming Soon)	KY's Open Portal Solution (Login Required)	IHSDM	Performance Based Practical Design	Recommended Tasks & Hours - DRAFT	FDOT DDSA Manual
	Guide to KYTC Collision Data	CAPX/SPICE	Potential for Crash Reduction the NEW Critical Rate Factor	Summary of SPFs and AFs SHIFT Safety	Iowa DOT DDSA Manual
	HIVEi (KYTC Only)	DDSA Resources	Observed, Predicted and Expected Crashes – Video		LADOTD DDSA Manual
		Comparison of the Tools	The Predictive Method - Video		Acronyms and Terms

One Stop Business Portal

https://onestop.ky.gov/Pages/default.aspx




MYKY
MyKentucky.gov
FAQ
Help
English
Welcome to the Kentucky Online Gateway
I am a
Citizen or Business Partner
State Employees and Contractors logging in with Email Address or Username
State Employees and Contractors logging in with KHRIS ID
Sign In
Create Account

Please complete your Kentucky Online Gateway Profile

If you already have an existing Kentucky Online Gateway (KOG) Account, please click here to reset your password **OR** click on the **Cancel** button below to log into your account.

Please fill out the form below and click **Sign Up** when finished.

All fields with * are required.

* First Name

Middle Name

* Last Name

* E-Mail Address

* Verify E-Mail Address

* Password

* Verify Password

Mobile Phone

Language Preference

English

Street Address 1

Street Address 2

City

State

Kentucky

Zip Code

Question

In what city were you born? (Enter full name of city only)

* Answer

Question

What was the name of your first pet?

* Answer

Cancel

Sign Up

After Account is created:

- Visit DDSA Website
- Request Access
- Webmaster (Jarrod) will approve and assign a group
- Browse the site

Kentucky-Specific SPF Spreadsheets

William Staats, PE

Purpose

- Allow for easy application of the Kentucky-specific SPFs
- Ensures uniform use of the SPFs across the state
- Assists in safety analysis and identifying high crash segments
- *Spreadsheets are currently in draft form and are not fully operational

SPF Development

- SPFs were developed for the SHIFT 2020 cycle
- 8 roadway types and 36 intersection types
- Calibrated to balance between accuracy and the amount of data needed

Base Conditions

- Base conditions are the common characteristics of the dataset used to calibrate an SPF
- Different for each roadway type
- Any segment differing from its SPF's base conditions needs an adjustment factor to account for the difference

Uniform Segments

- Segments must be uniform with respect to each SPFs base conditions

Roadway Type	Must be uniform with respect to:						
Rural Two Lane	No Intersections	AADT	Lane width	Shoulder width	Median width	Horizontal curve degree	Grade
Urban Two Lane	No Intersections	AADT					
Rural Interstate/Parkway	No Intersections	AADT					
Urban Interstate/Parkway	No Intersections	AADT					
Rural Multilane Divided	No Intersections	AADT	Shoulder Width				
Rural Multilane Undivided	No Intersections	AADT	Lane Width				
Urban Multilane Divided	No Intersections	AADT	Median Width				
Urban Multilane Undivided	No Intersections	AADT	Lane width				

Obtaining Crash Data

- Create uniform segments table
- Import .csv into CDAT
- Export crash data

Using the Spreadsheets

- Follow color-coded instructions on “Instruction” tab
- Each roadway type is a separate tab
- All data is summarized in the “Summary” tab

Instruction

Need Data Input
Calculated for you
SPF Parameters

Instructions:
1. Follow the color coded guide to identify the data necessary for a user to input.
2. All roadway segments must be uniform with respect to the necessary data elements for each roadway type (as seen listed below). The necessary data elements for each roadway type are based on the base conditions for each SPF. Uniform segments should not include intersections.
3. Find the tab corresponding to the roadway type for your data. If multiple roadway types are being assessed at once, data may be entered into multiple tabs. Enter your data in their respective green columns. Each row represents a single uniform roadway segment.
4. The SPF predicitons, adjustment factors, EB expected crashes, and EEC will be calculated automatically for each segment entered.
5. View the "Summary" tab to see a summary of crash metrics for all the uniform segmenets you entered. In the event a project spans multiple roadway types, the summary tab will show a break down of the crash metrics by roadway type.

Roadway Type	Must be uniform with respect to:						
Rural Two Lane	No Intersections	AADT	Lane width	Shoulder width	Median width	Horizontal curve degree	Grade
Urban Two Lane	No Intersections	AADT					
Rural Interstate/Parkway	No Intersections	AADT					
Urban Interstate/Parkway	No Intersections	AADT					
Rural Multilane Divided	No Intersections	AADT	Shoulder Width				
Rural Multilane Undivided	No Intersections	AADT	Lane Width				
Urban Multilane Divided	No Intersections	AADT	Median Width				
Urban Multilane Undivided	No Intersections	AADT	Lane width				

Rural Multilane Divided

ID	RT_UNIQUE	BEGIN_MP	END_MP	AADT	Total Crashes	Shoulder Width	Length	SH_AF	SPF	AdjustedSPF	Weight	EB_Estimate	EEC
							0	1.18	0	0	#DIV/0!	#DIV/0!	#DIV/0!

Alpha	-5.337
Beta	0.768
Phi	1.951

Summary Table

	Total Observed Crashes	Total SPF Predicted	Total EB	Total EEC
Rural Two Lane	0	0	#DIV/0!	#DIV/0!
Urban Two Lane	0	0	#DIV/0!	#DIV/0!
Rural Interstate/Parkway	0	0	#DIV/0!	#DIV/0!
Urban Interstate/Parkway	0	0	#DIV/0!	#DIV/0!
Rural Multilane Divided	0	0	#DIV/0!	#DIV/0!
Rural Multilane Undivided	0	0	#DIV/0!	#DIV/0!
Urban Multilane Divided	0	0	#DIV/0!	#DIV/0!
Urban Multilane Undivided	0	0	#DIV/0!	#DIV/0!
Ramps				
Intersections				
Total	0	0	#DIV/0!	#DIV/0!

Application of CMFs

Jared Love, PE, PTOE, PMP

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Apply CMFs to Calculated SPF Values

- Review applicable SPF “base case” or typical features
- Determine how study site differs from “base case”
- Select CMFs for road type and atypical features from Part C
- Multiply SPF value by applicable CMFs

Base Conditions
2-Lane Rural Highways

Intersections

- 90º angle (0º skew)
- No left turn lanes
- No right turn lanes
- No Lighting

Road segments

- 12-ft lane widths
- 6-ft shoulder widths
- Roadside Hazard Rating -- 3
- 5 driveways per mile
- Tangent, flat alignment (No vertical grade)
- No centerline rumble strips
- No passing lanes
- No two-way left turn lanes
- No lighting
- No automated speed enforcement

Base Conditions
Multilane Rural Arterials

Intersections

- 90° angle (0° skew)
- No left turn lanes
- No right turn lanes
- No Lighting

Road segments

- 12-ft lane widths
- 8-ft shoulder widths
- 30-ft median
- No lighting
- No automated speed enforcement

Base Conditions Urban and Suburban Arterials

Intersections

- No left turn lanes
- Permissive left-turn signal phasing
- No right turn lanes
- Right-turn on red permitted
- No Lighting
- No automated enforcement
- No bus stops, schools or alcohol sales establishments near

Road segments

- No on-street parking
- No roadside fixed objects
- 15-ft median
- No lighting
- No automated speed enforcement

Crash Modification Factor (CMF)

- Expected Crashes = CMF x (base condition crashes)
- You can remember it as “M is for multiply”

CMF Example

CMF = 0.90 % Reduction in Crashes

Expected crashes

= CMF* (base condition crashes)

=0.9* base condition crash frequency

Apply CMF ONLY if:

- Known base conditions
- Setting and road type
- AADT range
- Crash type and severity

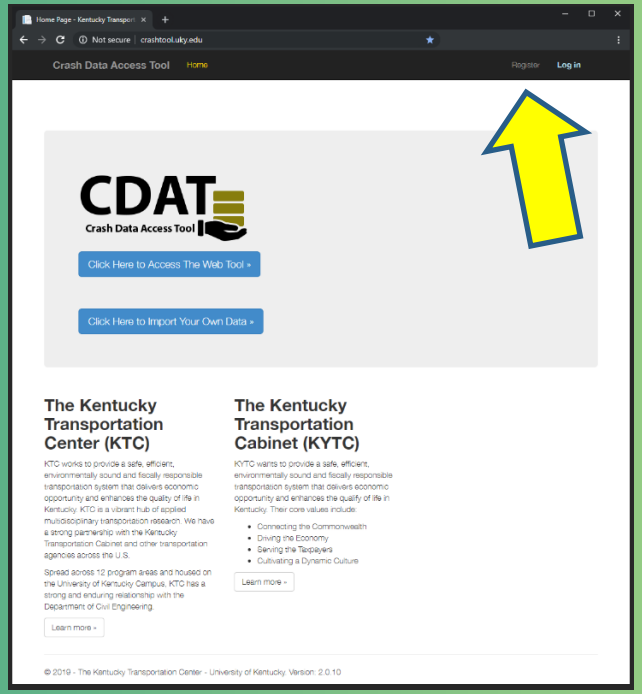
Crash Data ~~Access~~ Analysis Tool

Eric Green, PE

What is CDAT?

- Integrates crash with road data
- Includes advanced crash flags
- Includes HSM-based analysis
- Compare to similar roads/regions
- More than KYOPS
- Updated once a year (matches rates report)
- Maps… coming soon!

http://crashtool.uky.edu



Access

- **Anonymous**: no access to CDAT
- **Basic:** A basic user has access to information currently available to the public.
- **Advanced:** An advanced user has a current and signed MOU on file with KYTC and has access to information as outlined in that agreement

Functionality

- Query mode:
  - Country, route and milepoint range
- Import mode:
  - Upload your own file

Step One

Please define a county, route and starting/ending milepoints.

County:

ADAIR

Limit to Prefix:

CR CS FD KY LN PR PS PV

Clear Prefix

Route:

001-KY-0055 -000

Only Show Main Line Only Show Ramps Show All

More information on main line, ramps, and other section IDs can be found here.

Milepoints:

0 to 5

Step Two

Please define the crash type.

Severity:

- [x] K (Killed)
- [x] A (Suspected Serious Injury*)
- [x] B (Suspected Minor Injury*)
- [x] C (Possible Injury)
- [x] O (Property Damage Only)
- [x] U (unknown)
- [x] H (hit and run where injury is not known)

New categories used starting in 2017

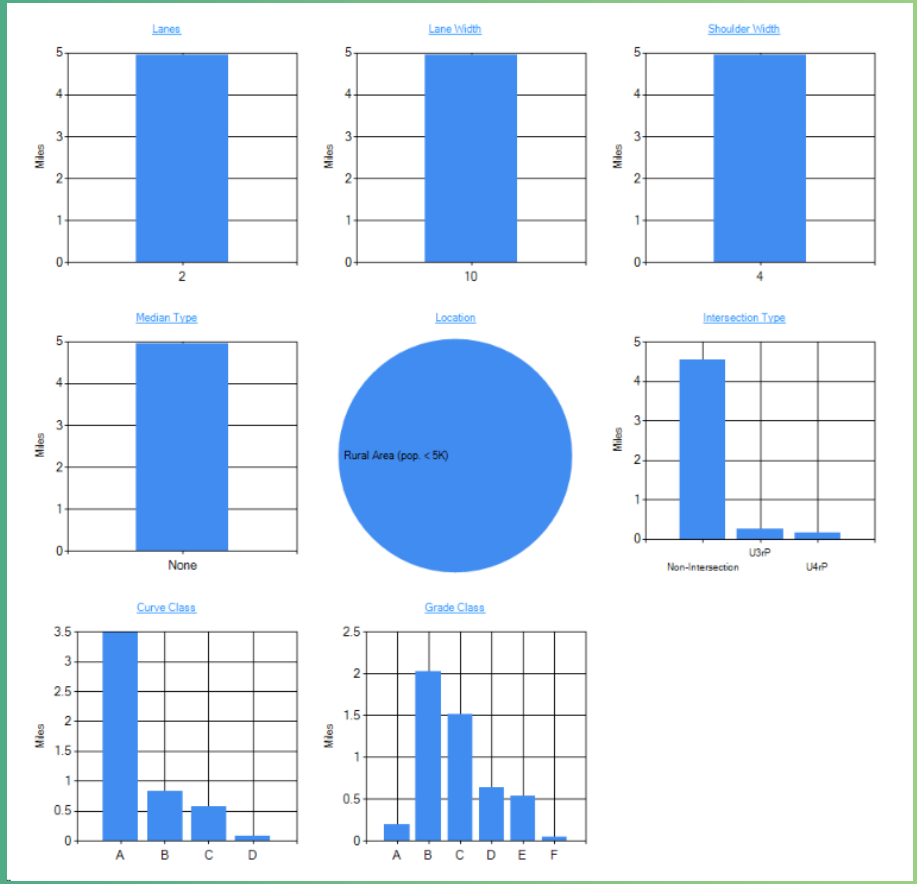
Include:

- [ ] Motorcycle
- [ ] Commercial Vehicle
- [ ] Lane Departure
- [ ] Run Off the Road
- [ ] Young Driver
- [ ] Mature Driver
- [ ] Pedestrian Involved
- [ ] Bicyclist Involved
- [ ] Distracted Driving
- [ ] Agressive Driving
- [ ] Impaired Driving
- [ ] Unrestrained
- [ ] Hit and Run

(•) Intersections and Non-Intersections ( ) Intersections only ( ) Non-intersections only

(•) Private property and Public ( ) Private property only ( ) Public only

(•) Parking Lot and Non-Parking Lot ( ) Parking lot only ( ) Non-Parking lot only

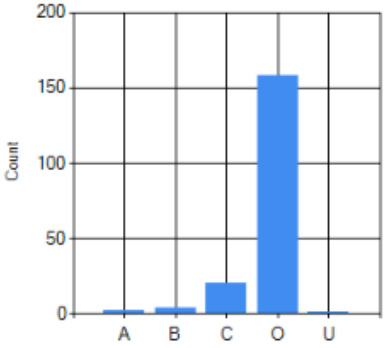

Lanes
Miles
5
4
3
2
1
0
2
Lane Width
Miles
10
Shoulder Width
Miles
4
Median Type
Miles
None
Location
Rural Area (pop. < 5K)
Intersection Type
Miles
Non-Intersection
U3rP
U4rP
Curve Class
Miles
3.5
2.5
1.5
0.5
A
B
C
D
Grade Class
Miles
2.5
2
1.5
1
0.5
A
B
C
D
E
F

OBJECTID	RT_UNIQUE	BEGIN_MP	END_MP	CO_NAME	DISTRICT	UrbanType	FC	AADT	MedianType	LaneWidth	LANES	GRADECLS	CURVECLS	ShoulderWidth	Length	IntsctClass
5484	001-KY-0055-000	0.00000000	0.01900000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	E	A	4.00000000	0.01900000	
5485	001-KY-0055-000	0.01900000	0.20900000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	B	A	4.00000000	0.19000000	
5499	001-KY-0055-000	0.20900000	0.27900000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	B	B	4.00000000	0.07000000	
5497	001-KY-0055-000	0.27900000	0.29400000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	C	B	4.00000000	0.01500000	
5224	001-KY-0055-000	0.29400000	0.31300000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	C	B	4.00000000	0.01900000	U4rP
5225	001-KY-0055-000	0.31300000	0.34000000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	C	B	4.00000000	0.02700000	U4rP
5223	001-KY-0055-000	0.34000000	0.35900000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	C	B	4.00000000	0.01900000	U4rP
5496	001-KY-0055-000	0.35900000	0.38300000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	C	B	4.00000000	0.02400000	
5498	001-KY-0055-000	0.38300000	0.40000000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	B	B	4.00000000	0.01700000	
5226	001-KY-0055-000	0.40000000	0.41900000	Adair	8.00000000	Rural Area (pop. < 5K)	5	704.00000000	None	10.00000000	2.00000000	B	B	4.00000000	0.01900000	U3rP

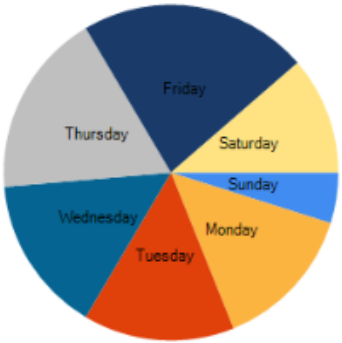
1 2 3 4 5 6 7 8 9 10 ...

Crash Data:

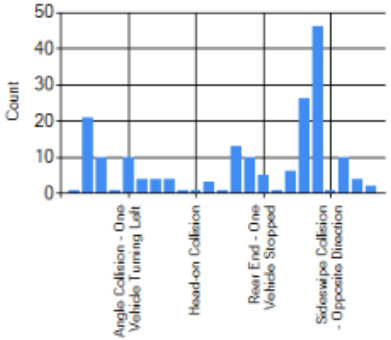
KABCO



Day of Week



Directional Analysis



185 crashes found

MP	RT_Unique_KTC	Longitude	Latitude
0.306	001-KY-0055 -000	-85.30237	37.08729
0.989	001-KY-0055 -000	-85.30219	37.09655
1.899	001-KY-0055 -000	-85.30308	37.10767
1.709	001-KY-0055 -000	-85.30354	37.10509
4.269	001-KY-0055 -000	-85.2543	37.02387
4.046	001-KY-0055 -000	-85.25345	37.02074
1.458	001-KY-0055 -000	-85.3054	37.10218
0.817	001-KY-0055 -000	-85.30315	37.09395
0.859	001-KY-0055 -000	-85.30273	37.0945
0.813	001-KY-0055 -000	-85.30317	37.09389
1 2 3 4 5 6 7 8 9 10 ...			

Download Data

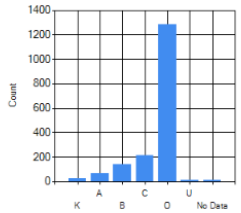
Show crash data on roads with these geometrics:

- (•) 2 - Lanes
- (•) 10 ft Lane Width
- (•) 4 ft Shoulder Width
- (•) None
- (•) Rural Area (pop. < 5K)
- (•) Non-Intersection ( ) U3rP ( ) U4rP
- (•) A ( ) B ( ) C ( ) D
- ( ) A (•) B ( ) C ( ) D ( ) E ( ) F

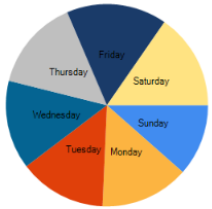
Limit data to these regions:

- (•) No Region Filter
- ( ) County
- ( ) Highway District
- ( ) KSP Post
- ( ) Area Development District

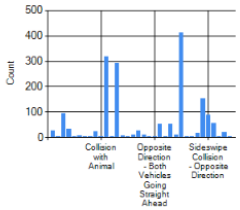
KABCO



Day Of Week



Directional Analysis



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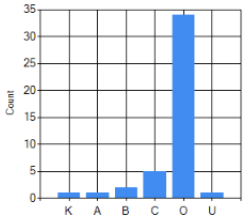
- (•) Non-Intersection ( ) U3rP ( ) U4rP
- (•) A ( ) B ( ) C ( ) D
- ( ) A (•) B ( ) C ( ) D ( ) E ( ) F

Limit data to these regions:

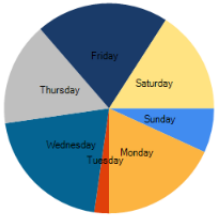
- ( ) No Region Filter
- (•) County
- ( ) Highway District
- ( ) KSP Post
- ( ) Area Development District

ADAIR

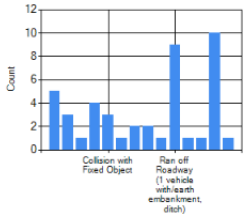
KABCO



Day Of Week



Directional Analysis



Step Three

Please select an SPF for the segment (intersections coming soon!)

- (•) Rural Two-Lane
- ( ) Urban Two-Lane
- ( ) Rural Multi-Lane Divided
- ( ) Rural Multi-Lane Undivided
- ( ) Urban Multi-Lane Divided
- ( ) Urban Multi-Lane Undivided
- ( ) Rural Interstate and Parkway
- ( ) Urban Interstate and Parkway
- ( ) No SPF recommended

[Perform Advanced Analysis]

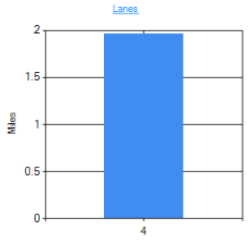
Number of Crashes: 185
Theta: 1.532

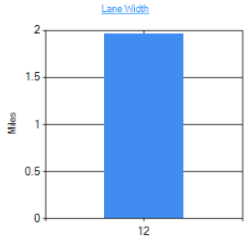
Model form: SPF = e^a*AADT^b*Length
Length: 4.96
AADT: 914.1
a -4.492
b 0.844

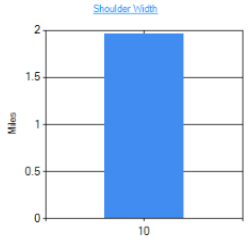
Results:

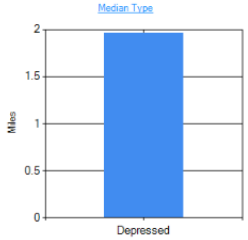
Crash prediction at site		67.7	crashes per time period
Excess Expected Crashes (EEC)		173.2	crashes per time period
Confidance	+/-	7.8	crashes per time period

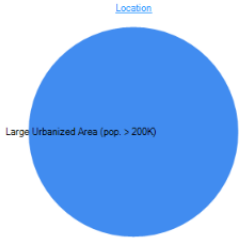
Roadway Data:

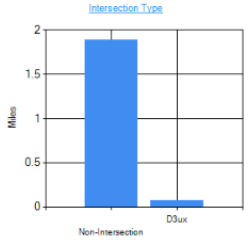


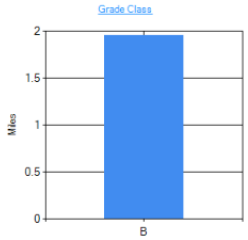












Step Three

Please select an SPF for the segment (intersections coming soon!)

- ○ Rural Two-Lane
- ○ Urban Two-Lane
- ○ Rural Multi-Lane Divided
- ○ Rural Multi-Lane Undivided
- ◉ Urban Multi-Lane Divided
- ○ Urban Multi-Lane Undivided
- ○ Rural Interstate and Parkway
- ○ Urban Interstate and Parkway
- ○ No SPF recommended

Perform Advanced Analysis

Number of Crashes: 73
Theta: 0.814

Model form: SPF = e^a*AADT^b*Length
Length: 1.959
AADT: 63845.1
a -4.171
b 0.761

Results:
Crash prediction at site 228.8 crashes per time period
Excess Expected Crashes (EEC) 74.1 crashes per time period
Confidance +/- 15.1 crashes per time period