

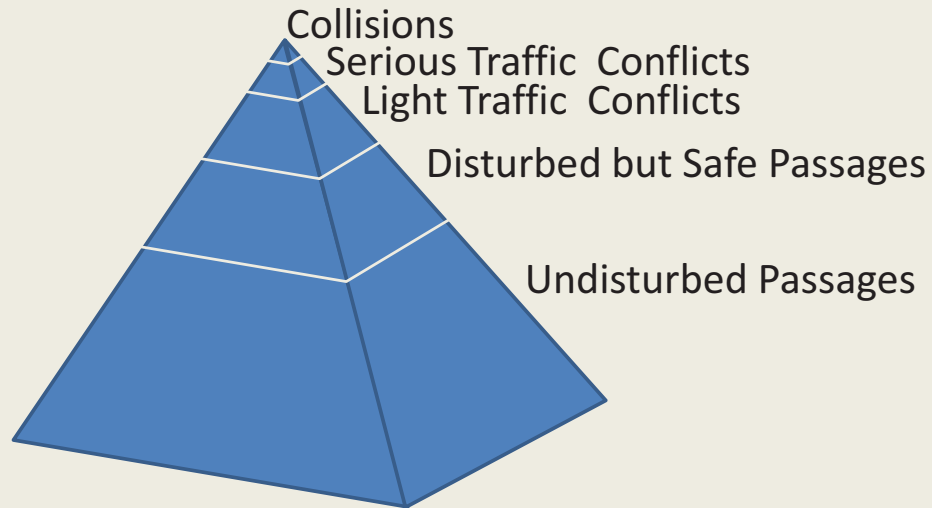
Unplanned Presentation

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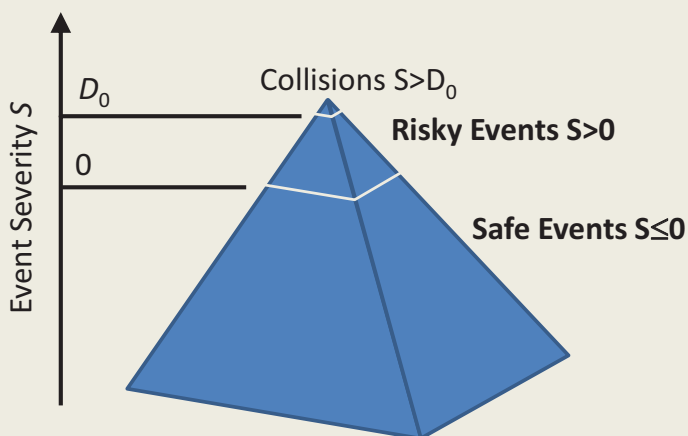
SURROGATE EVENT VS CRASH

Continuum of Traffic Events

(based on C. Hyden's concept)



Probability of Crash given a Risky Event (Severity Scale)



$F_E(D < D_0)$ = frequency of risky events (including crashes)

$F_C(D < 0)$ = frequency of crashes

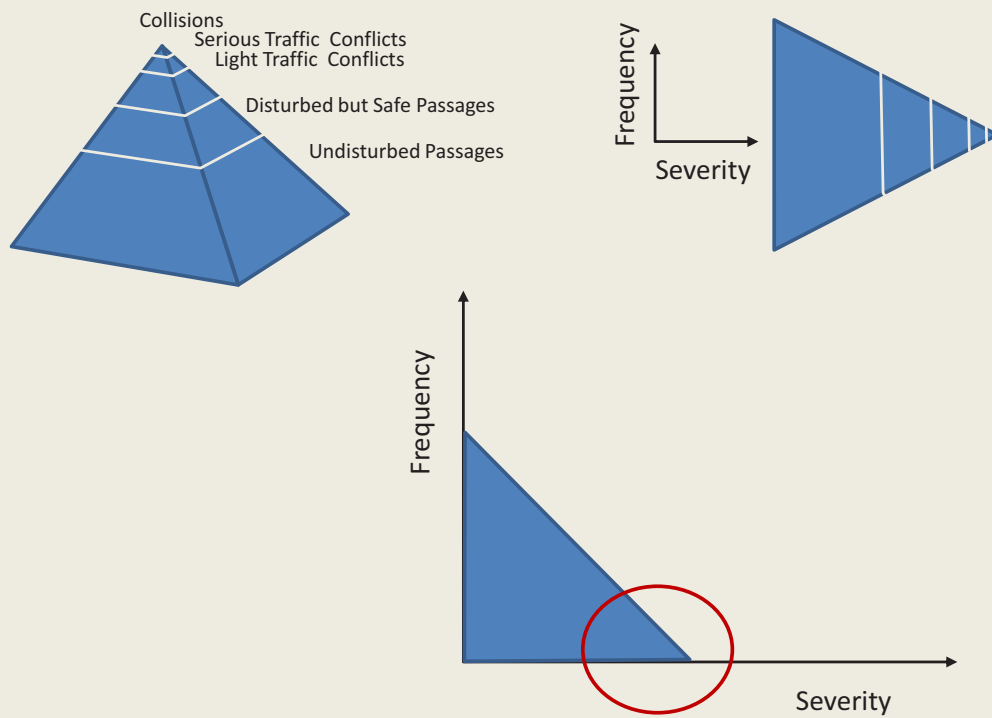
$P(C|E)$ = probability of a crash given a risky event

$$P(C|E) = F_C / F_E$$

$$F_C = P(C|E) \cdot F_E$$

$$F_C(X) = P(C|E, X) \cdot F_E(X)$$

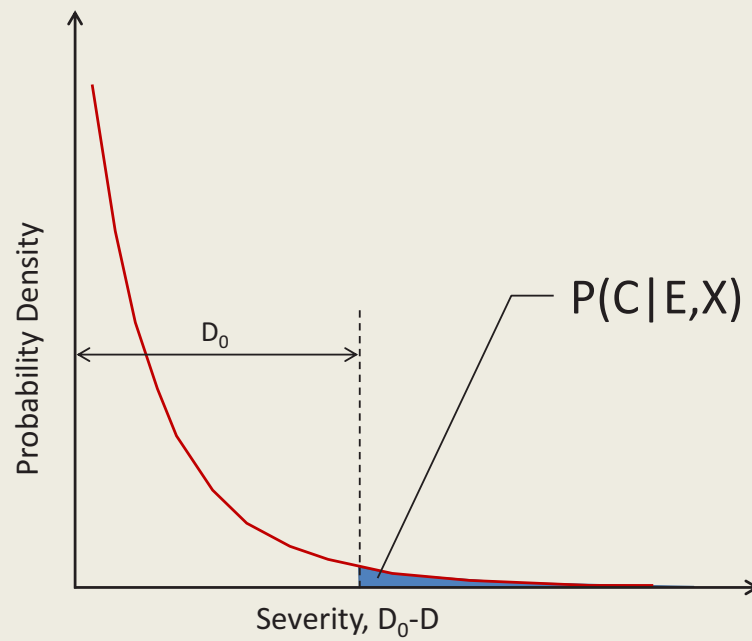
From Pyramid to Distribution of Events



Pareto Model $P(C|E,X)$

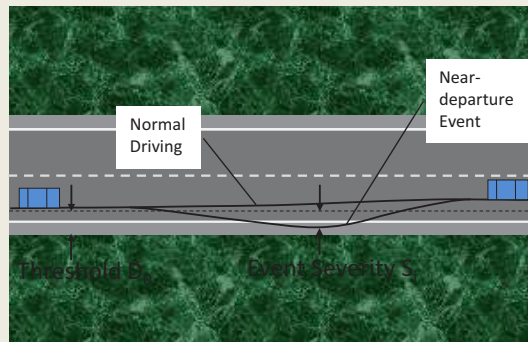


Pareto Model $P(C|E,X)$

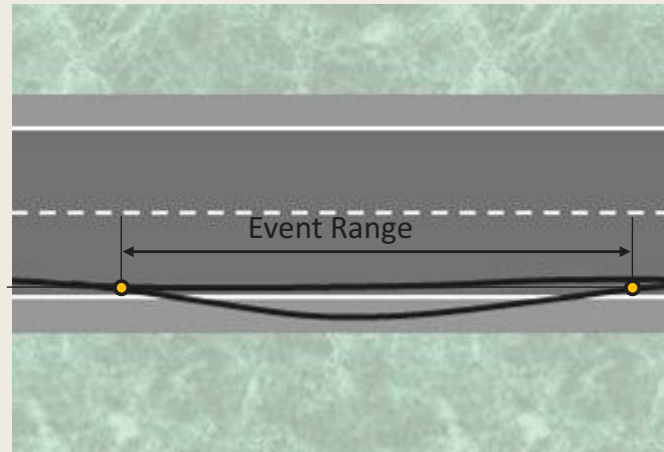


EXAMPLE – ROAD DEPARTURE

Near-departure Event

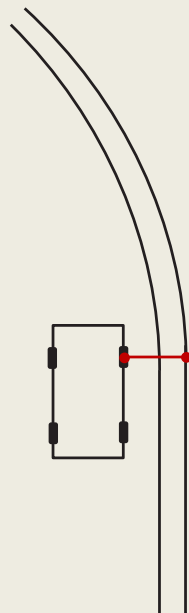


(Lateral Distance)

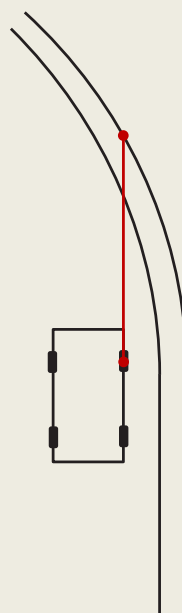


Alternative Measures of Event Severity

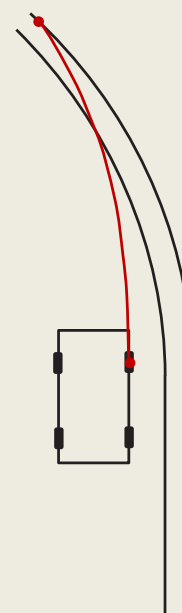
Lateral Distance **LD**



Time to Departure **TTD1**
(Constant Speed,
Straight Path)



Time to Departure **TTD2**
(Constant Rate of
Closing to Road Edge)



Pareto Model P(C|E)

$$f(s) = \begin{cases} \frac{1}{\sigma} \cdot \left(1 + k \cdot \frac{s - \theta}{\sigma}\right)^{-1 - \frac{1}{k}} & \text{for } (k > 0 \text{ and } \theta < s) \text{ or } (k < 0 \text{ and } \theta < s < -\sigma/k), \\ \frac{1}{\sigma} \cdot e^{-\frac{s - \theta}{\sigma}} & \text{for } k = 0 \text{ and } \theta < s. \end{cases}$$

where:

shoulder encroachment depth $s = D_0 - D$, $D_0 = 4$ ft,
 shape parameter k (to be estimated for conditions X),
 scale parameter σ (to be estimated for conditions X),
 threshold (location) parameter $\theta = 0$.

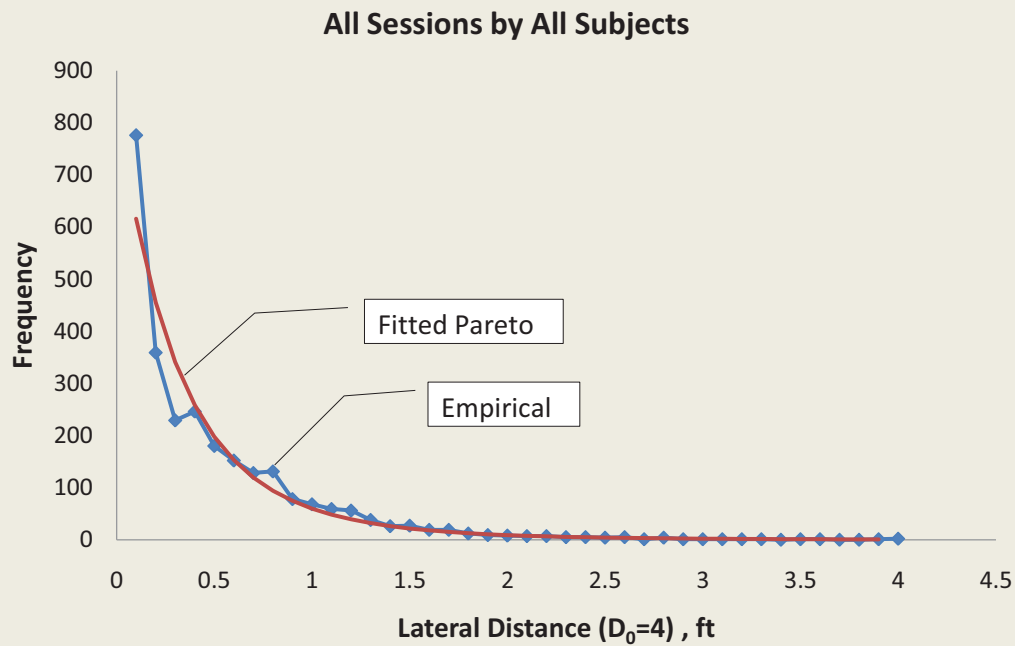
$$P(C|E) = F(S > D_0) = 1 - F(D_0)$$

Estimated Number of Departures

77 trips by four subjects, total 2,150 miles travelled

Severity Measure S	LD	TTD1	TTD2
Threshold D_0	4 ft	1.75 s	3.8 s
Number of risky events	2,662	2,319	2,786
Shape parameter	0.152 (0.098, 0.206)	-0.154 (-0.212, -0.095)	-0.260 (-0.293, -0.227)
Scale parameter	0.374 (0.350, 0.400)	0.407 (0.379, 0.437)	1.040 (0.990, 1.092)
Estimated risk of departure	0.0018 (0.0010, 0.0027)	0.00094 (0.00017, 0.0020)	0.000026 (0.0000, 0.00011)
Estimated number of departures	4.79 (2.81, 7.42)	2.17 (0.40, 4.63)	0.07 (0.00, 0.29)
Number of departures	4	4	4

Fit to Data – LD-based Model



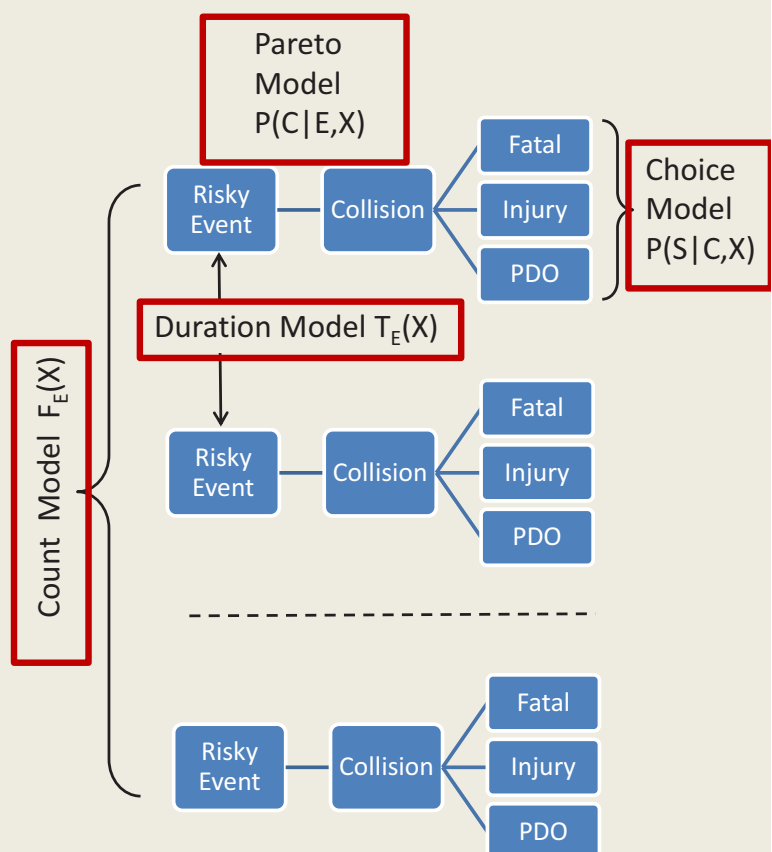
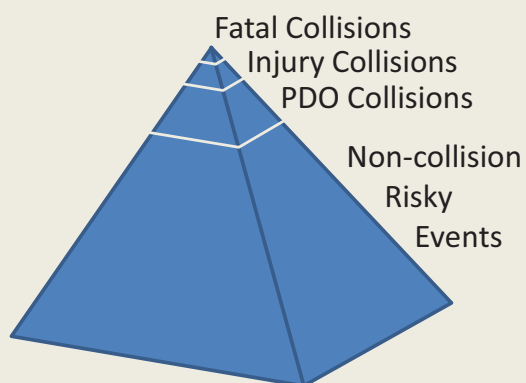
Results by Subject

LD-based Models

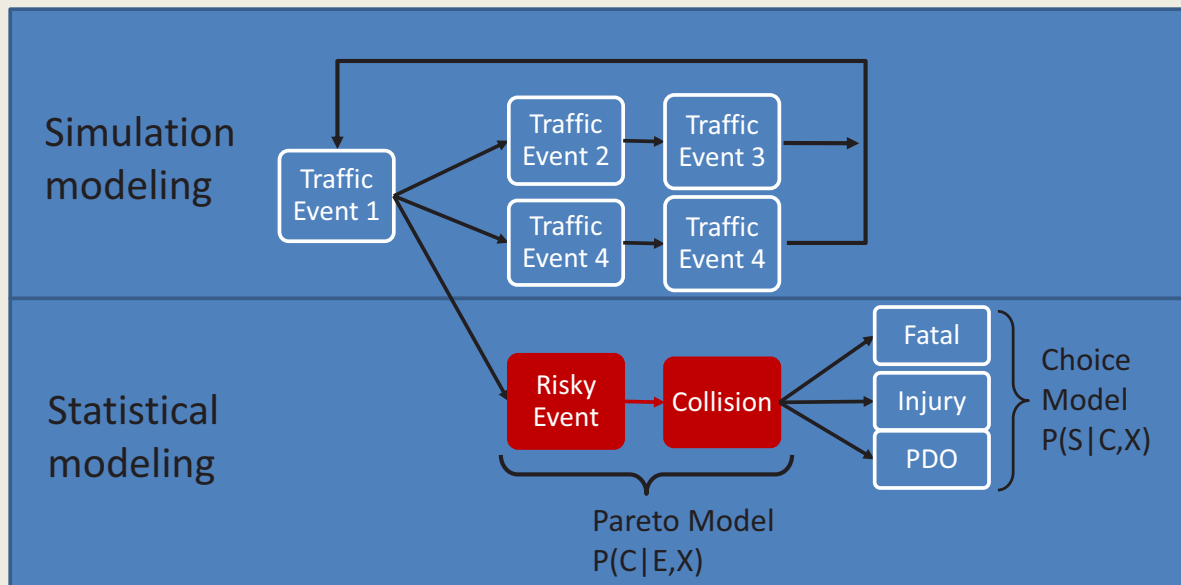
Subject	385	756	219	028
No. of sessions	19	20	19	19
Miles	522.5	550	522.5	522.5
Near-departures	605	640	1013	404
Shape parameter	0.051	0.1874	0.0174	0.151
Scale parameter	0.323	0.4287	0.5026	0.232
Risk of departure $P(C E)$	1.30E-04	4.60E-03	6.54E-04	3.08E-04
Near-departure rate F_F (1/1000 miles)	1158	1164	1939	773
Expected departure rate F_C (1/1000 miles)	0.15	5.21	1.24	0.24
5 th percentile	0.00	2.06	0.20	0.00
95 th percentile	0.55	9.08	3.02	0.81

SURROGATE EVENTS IN SAFETY MODELING

Risky Events in Modeling Collisions



Hybrid Approach to Modeling Collisions



LIDAR SYSTEM

LiDAR Scanner

(adopted from wikipedia: <http://en.wikipedia.org/wiki/LIDAR>)



Purdue Traffic Mobile Lab



Future Work

- Build a LiDAR system
 - Hardware integration
 - Data acquisition, reduction, and storage handling
 - System testing and evaluation
- Application software
- Research on safety measurement via surrogates







Purdue University and the Transportation Research Board will host the 3rd International Conference on Road Safety and Simulation in September 14-16, 2011, in Indianapolis, Indiana, USA. Papers that focus on modern methods and techniques for safety investigation, including driving simulators, naturalistic driving, and utilization of surrogate measures of safety, are welcome. In addition, papers that increase understanding of road crash causality, offer better safety models, and/or present the use of new methods, techniques, and models in safety management are sought.

ROAD SAFETY AND SIMULATION
RSS 2011
September 14-16, 2011
Indianapolis, USA

Roadway design
Human factors
Emerging technologies
New research methods
Crash causality

First Call

Conference objectives and focus:

- ❖ Facilitate a discussion of modern methods and techniques for road safety analysis and management
- ❖ Increase understanding of crash causality through the use of driver simulators, naturalistic driving, non-intrusive sensing technologies, and crash reporting
- ❖ Help identify new directions in safety modeling and management

Abstracts should be sent by e-mail to: rss2011@ecn.purdue.edu by February 15, 2011.

The submitted abstracts should not exceed 500 words and should include:

- title of the paper
- name and complete address of the corresponding author, including telephone number and e-mail address
- names of other authors with their affiliations
- abstract with key references

The corresponding authors will be invited on or before February 28, 2011 to write full papers, which will be due by May 2, 2011. The selected full papers will be published, after a peer review in special issues of prominent international journals: *Accident Analysis and Prevention*; *Advances in Transportation Studies - An International Journal*; and *ASCE Journal of Transportation Engineering*.

Conference website:
<https://engineering.purdue.edu/RSS2011>



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graph TD
    ND[Naturalistic Driving] --> UCC[Understanding Crash Causality Models]
    DS[Driving Simulators] --> UCC
    MT[Measurement Technologies] --> UCC
    SM[Surrogate Measures] --> UCC
    UCC --> SMgt[Safety Management]
      
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Important Dates

February 15, 2011
 February 28, 2011
 May 2, 2011
 June 15, 2011
 June 30, 2011
 September 14-16, 2011

Abstracts due
 February 15, 2011
Abstract acceptance notification
 February 28, 2011
Full papers due
 May 2, 2011
Full papers acceptance notification
 June 15, 2011
Early registration deadline
 June 30, 2011
Conference
 September 14-16, 2011

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