Unplanned Presentation

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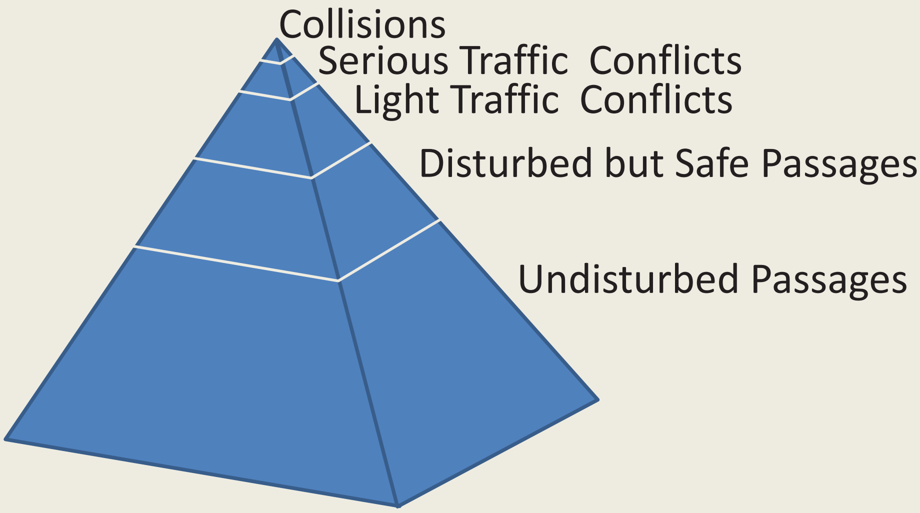
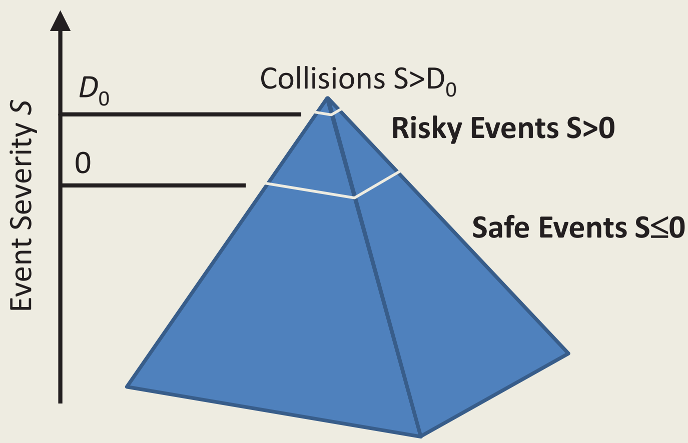
SURROGATE EVENT VS CRASH

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

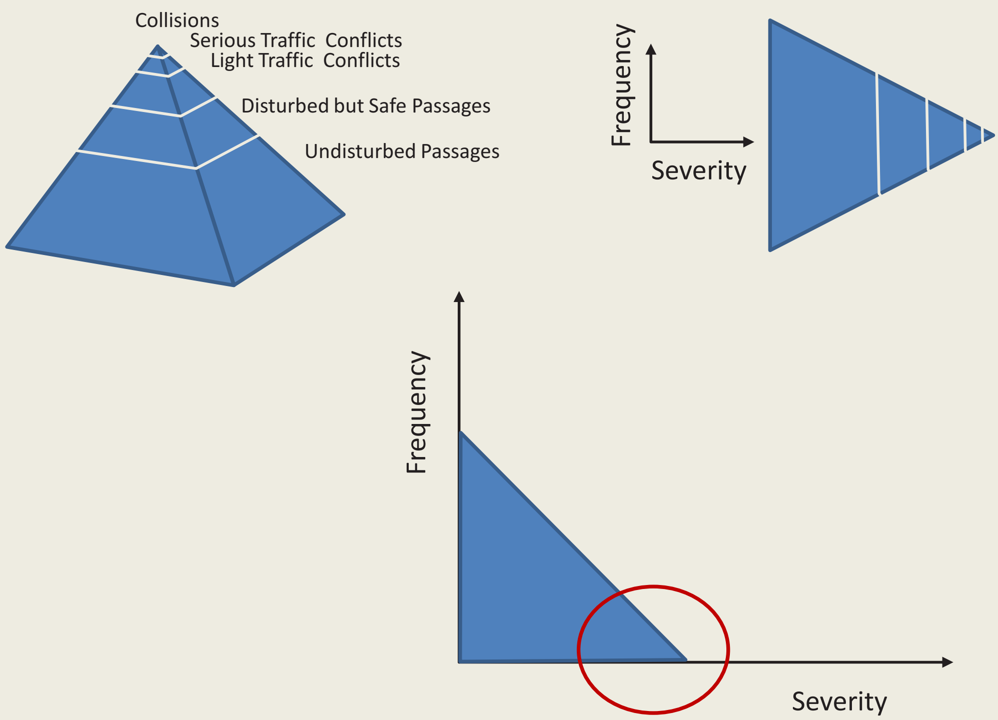
$P(C|E)$ = probability of a crash given a risky event

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

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

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

From Pyramid to Distribution of Events



Pareto Model P(C|E,X)

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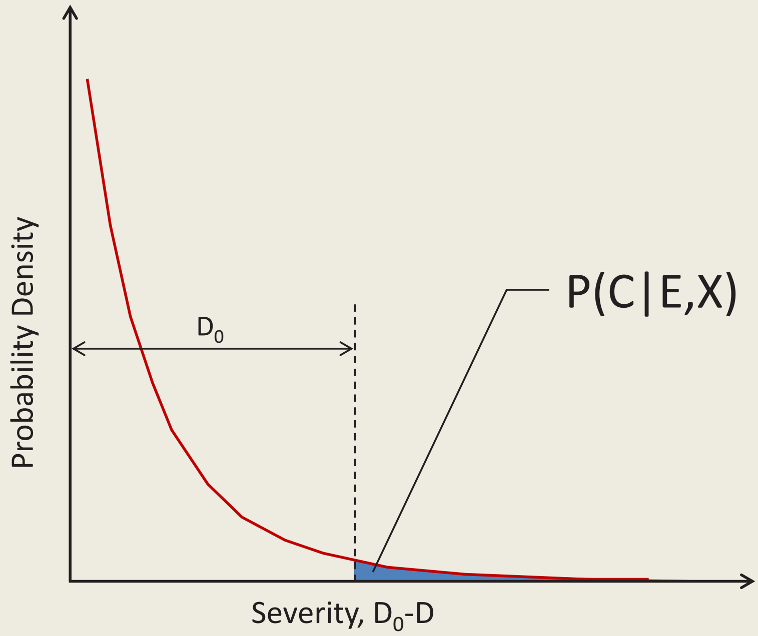
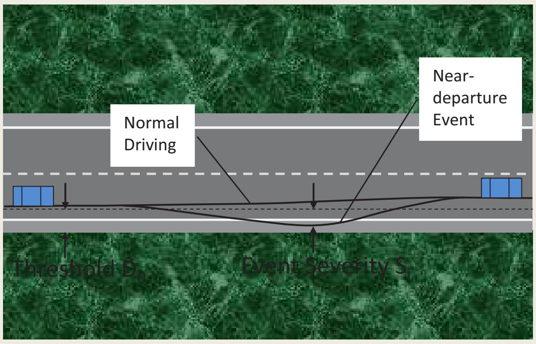
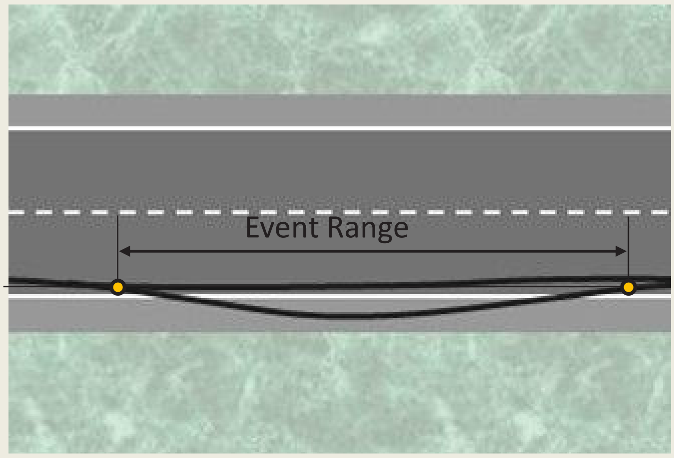


EXAMPLE – ROAD DEPARTURE

Near-departure Event

(Lateral Distance)



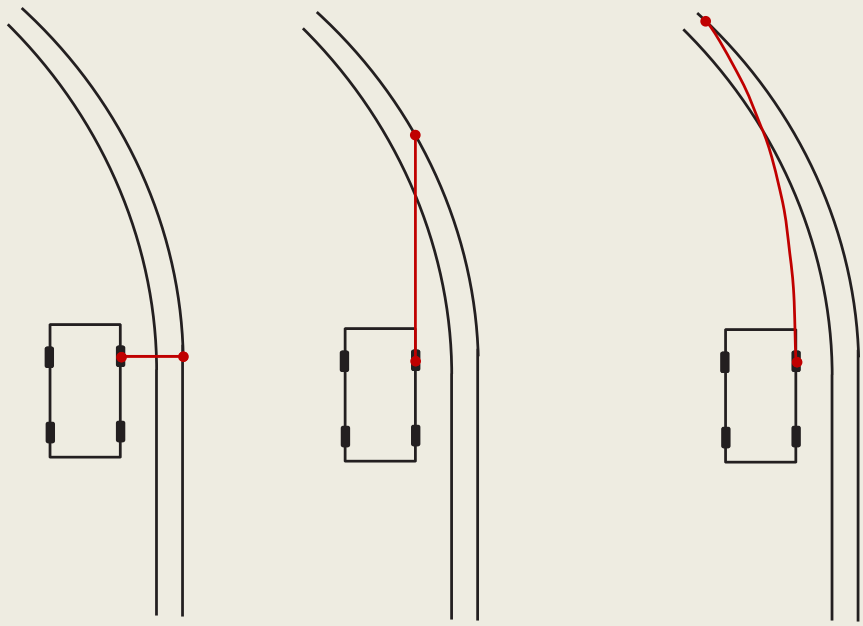


Alternative Measures of Event Severity

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

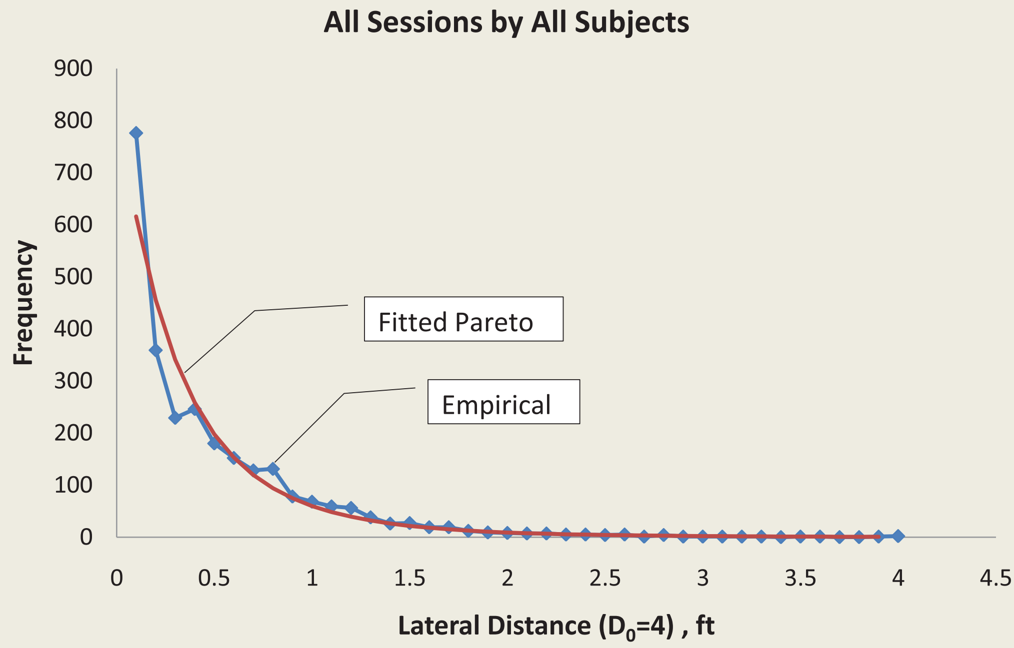
$P(C|E) = F(S>D_0) = 1 - F(D_0)$

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



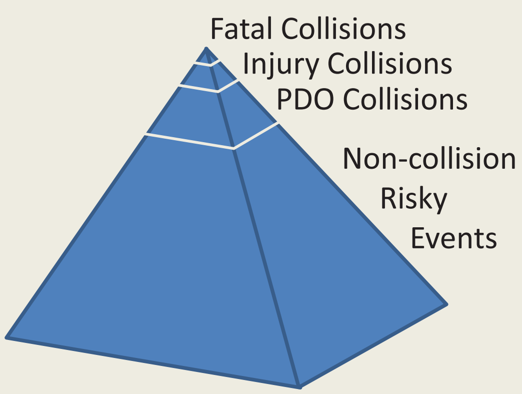
Results by Subject

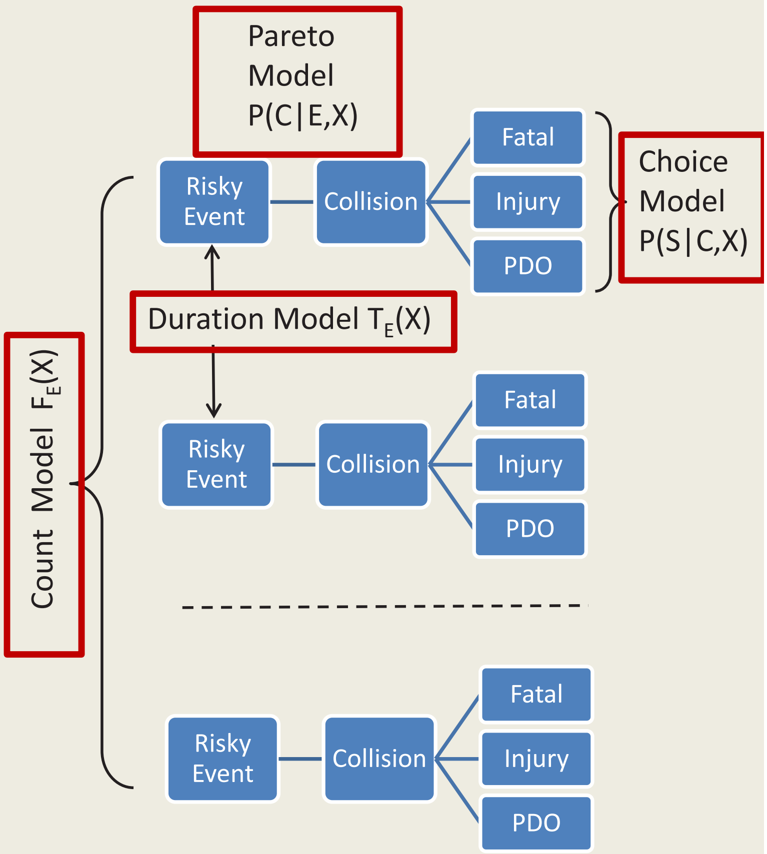
LD-based Models

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_E (1/1000 miles)	1158	1164	1939	773
Expected departure rate F_C (1/1000 miles)	**0.15**	**5.21**	**1.24**	**0.24**
5th percentile	0.00	2.06	0.20	0.00
95th percentile	0.55	9.08	3.02	0.81

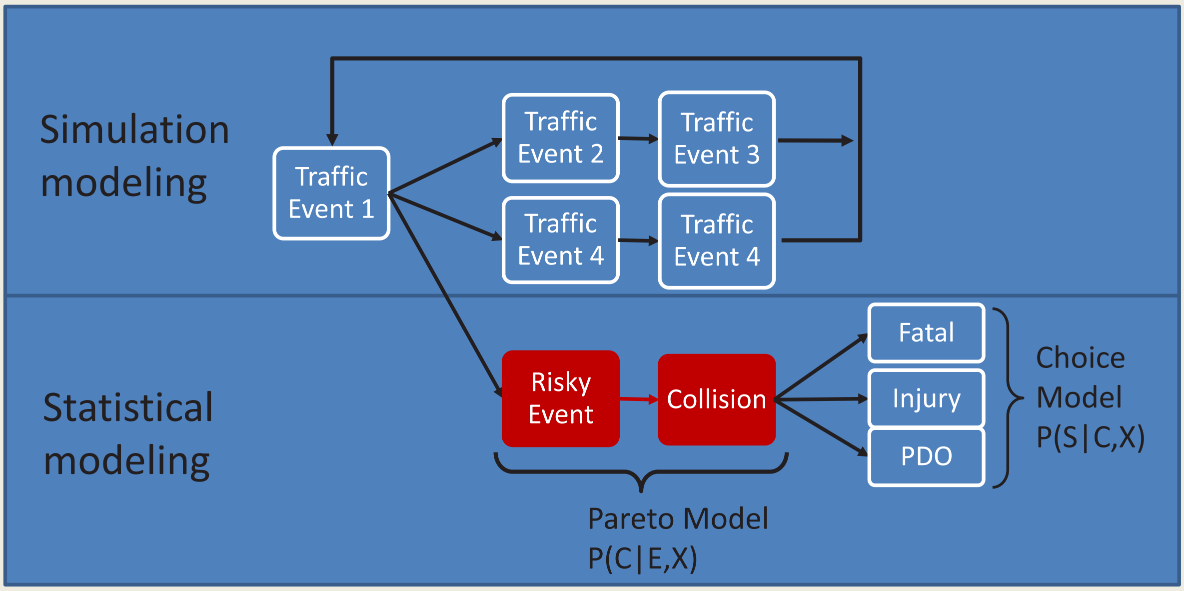
SURROGATE EVENTS IN SAFETY MODELING

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