

# Analysis of pedestrian-vehicle interactions using extreme value theory



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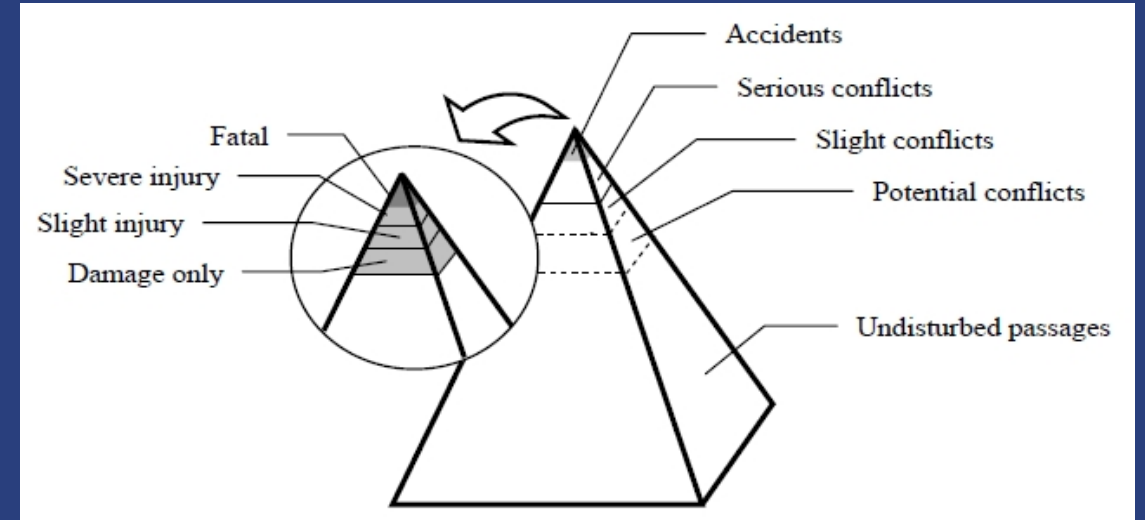
*Transoft Solutions, Canada*



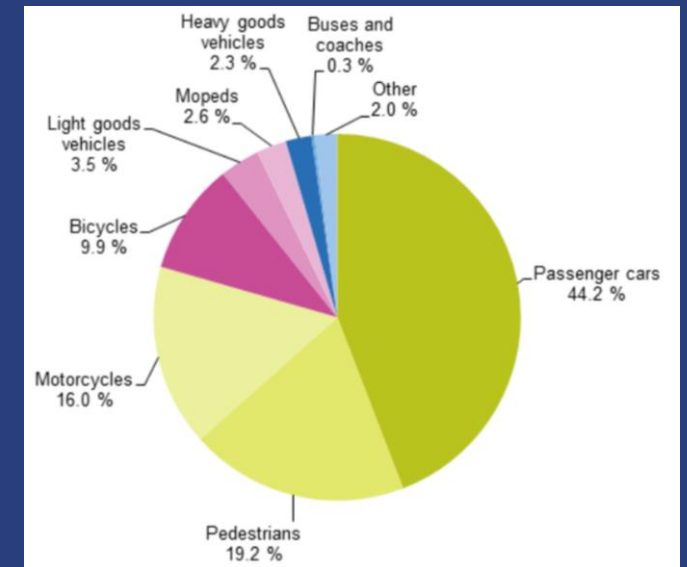
# Problem statement

## Problems with accidents

- Rare events
- At least 3 years of data (moral issue)
- Reactive approach
- Underreporting
- Quality of data



Pedestrians were the second largest category of road accidents in the EU in 2020.



# Surrogate Measures of Safety (SMS)

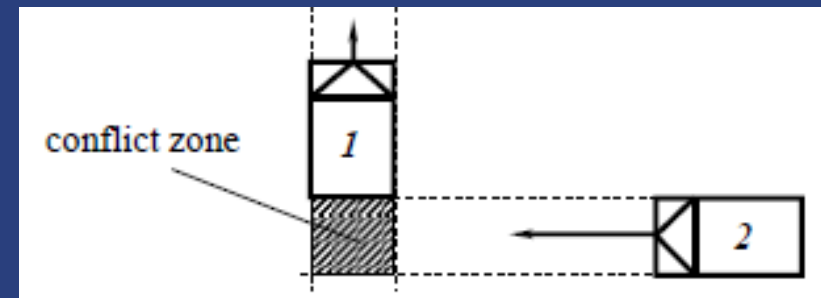
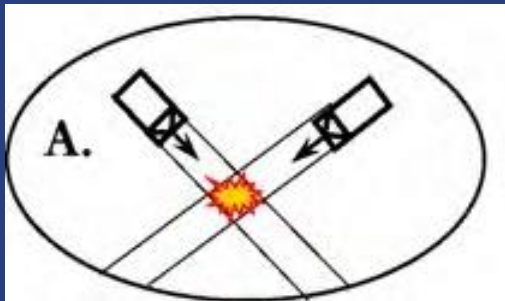
Surrogate = not accidents

Temporal, distance, deceleration based & other indicators

Most widely used:

Time to collision TTC

Post encroachment time PET



# Extreme Value Theory

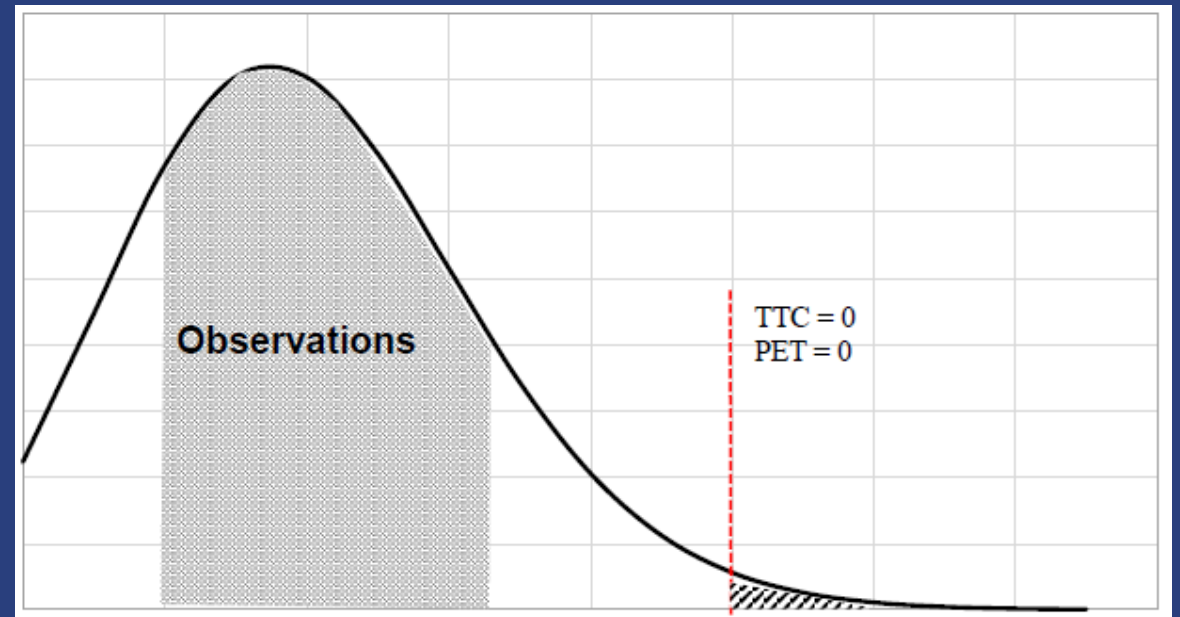
First study by Tarko (2006)

Linking EVT with accident data

Studies applied Block Maxima and/or Peak-over-Threshold

Contradicting results on which one is better

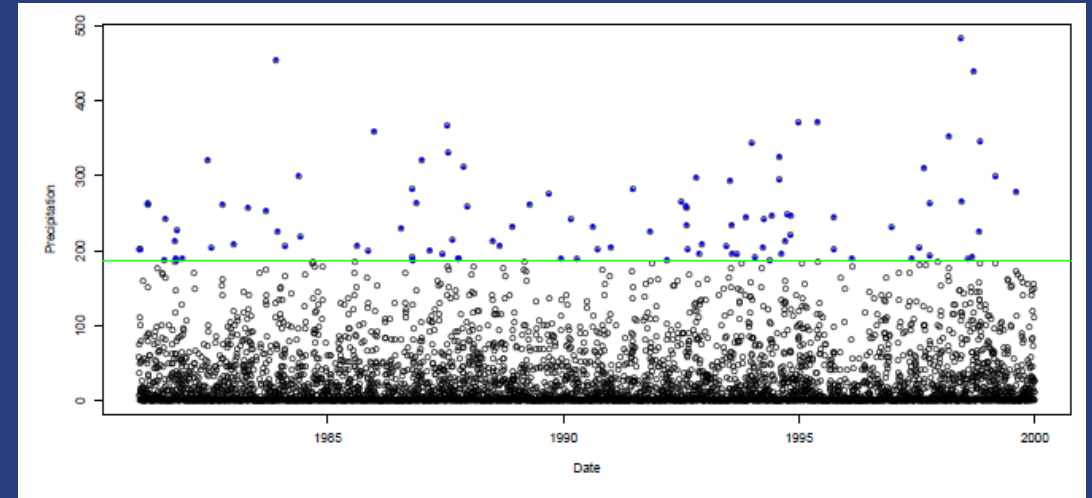
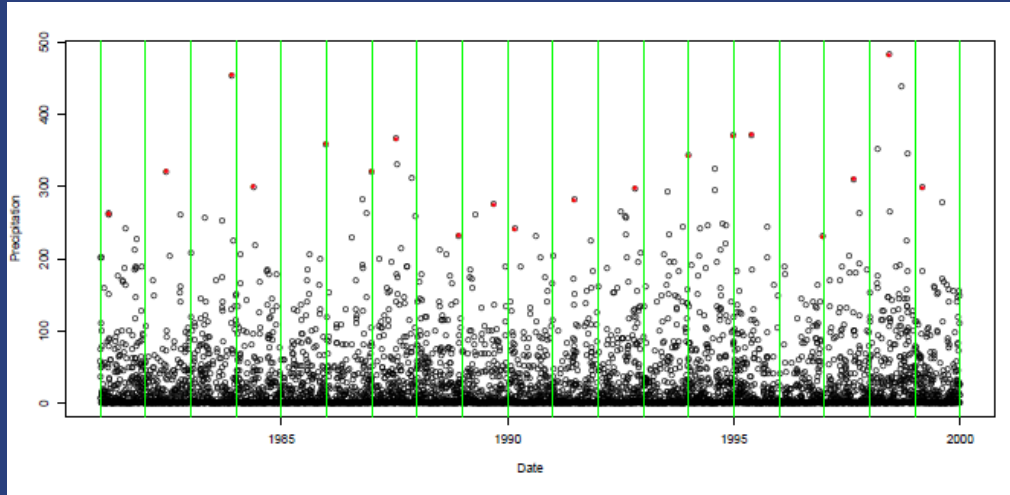
Mostly used TTC and PET



# BM

# vs.

# POT



$$G(z) = \exp \left\{ - \left[ 1 + \xi \left( \frac{z - \mu}{\sigma} \right) \right]^{\frac{-1}{\xi}} \right\}$$

GEV distribution  
block = interaction  
selection of near-crashes

$$H(x) = 1 - \left[ 1 + \xi \left( \frac{x - u}{\sigma_u} \right) \right]^{-1/\xi}$$

GPD distribution  
threshold selection (u)

In both cases: temporal indicators - negated values!

## Research question

What can we learn from applying EVT for vehicle-pedestrian interactions at unsignalized pedestrian crossings?

# Case study (Győr, Hungary)

1 light injury accident (2013-2022)

Camera set-up

Calibration

Peak hours (May-June, 2021)

06:00-09:00 am - 14:00-17:00 pm

594 videos (of approximately 85 hours and 48 minutes)

pedestrian – passenger car interactions

Two software used:

- TrafXSAFE (Transoft Solutions) – the results of this will be shown
- T-Analyst (Lund)



# TrafxSAFE (PET 1.24s)



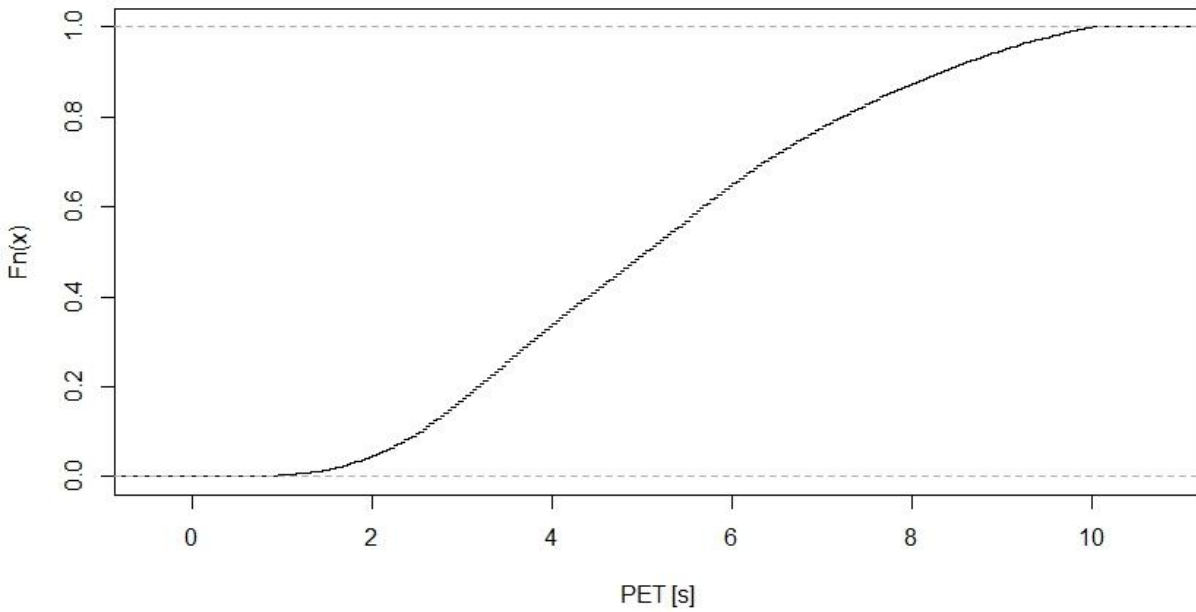


# T-Analyst (PET 0.2s)

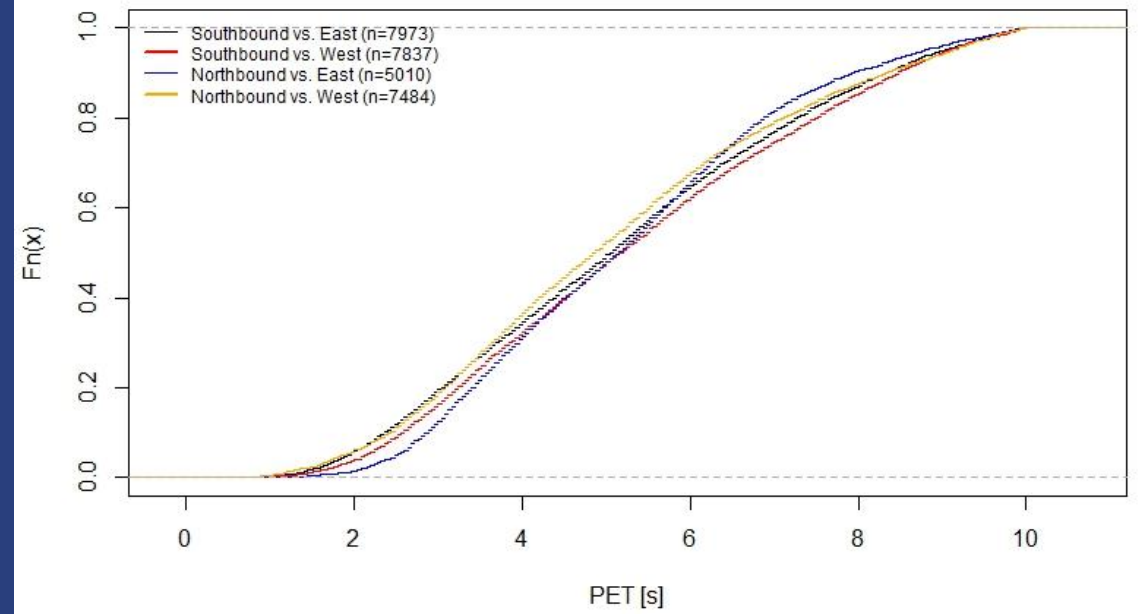


# PET CDF

PET distribution (n=28304)

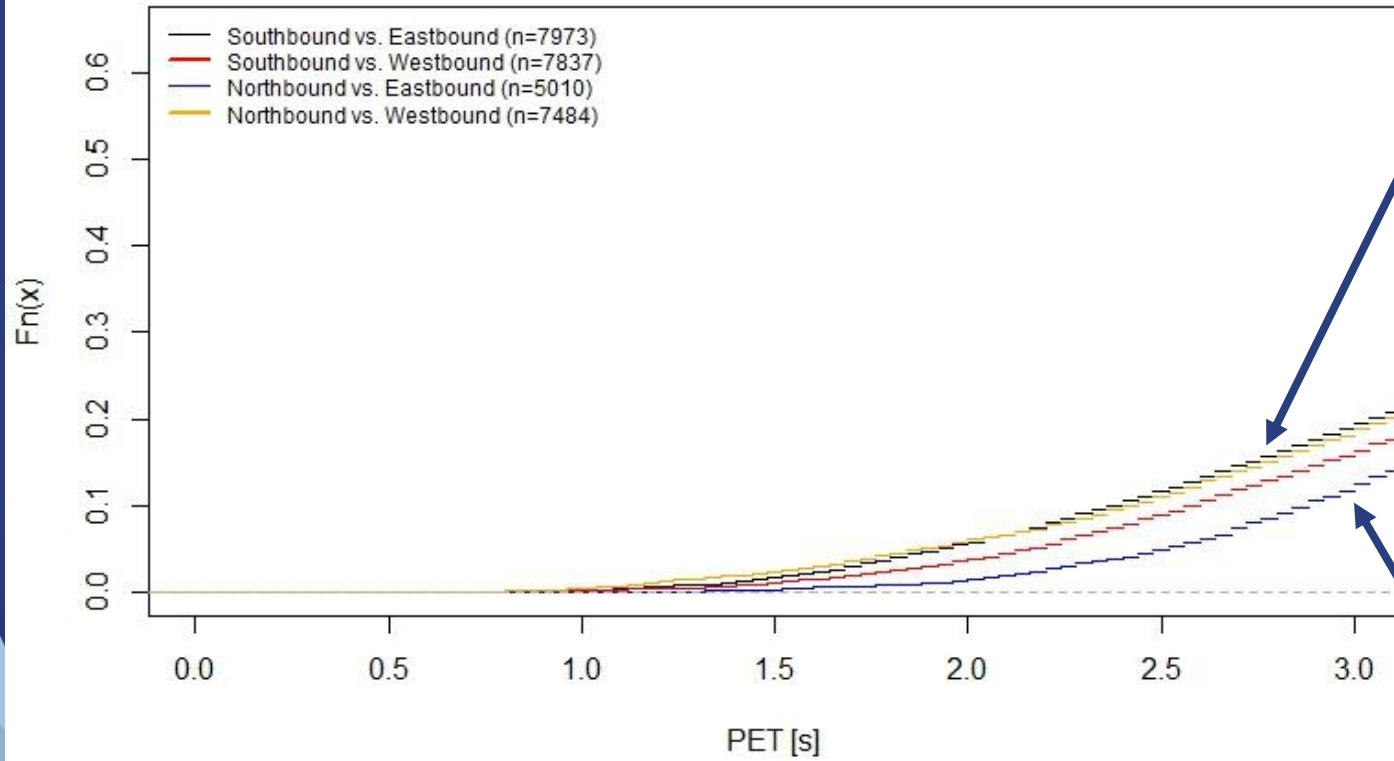


PET distributions (n=28304)



# PET CDFs per movement

PET distributions (n=28304)



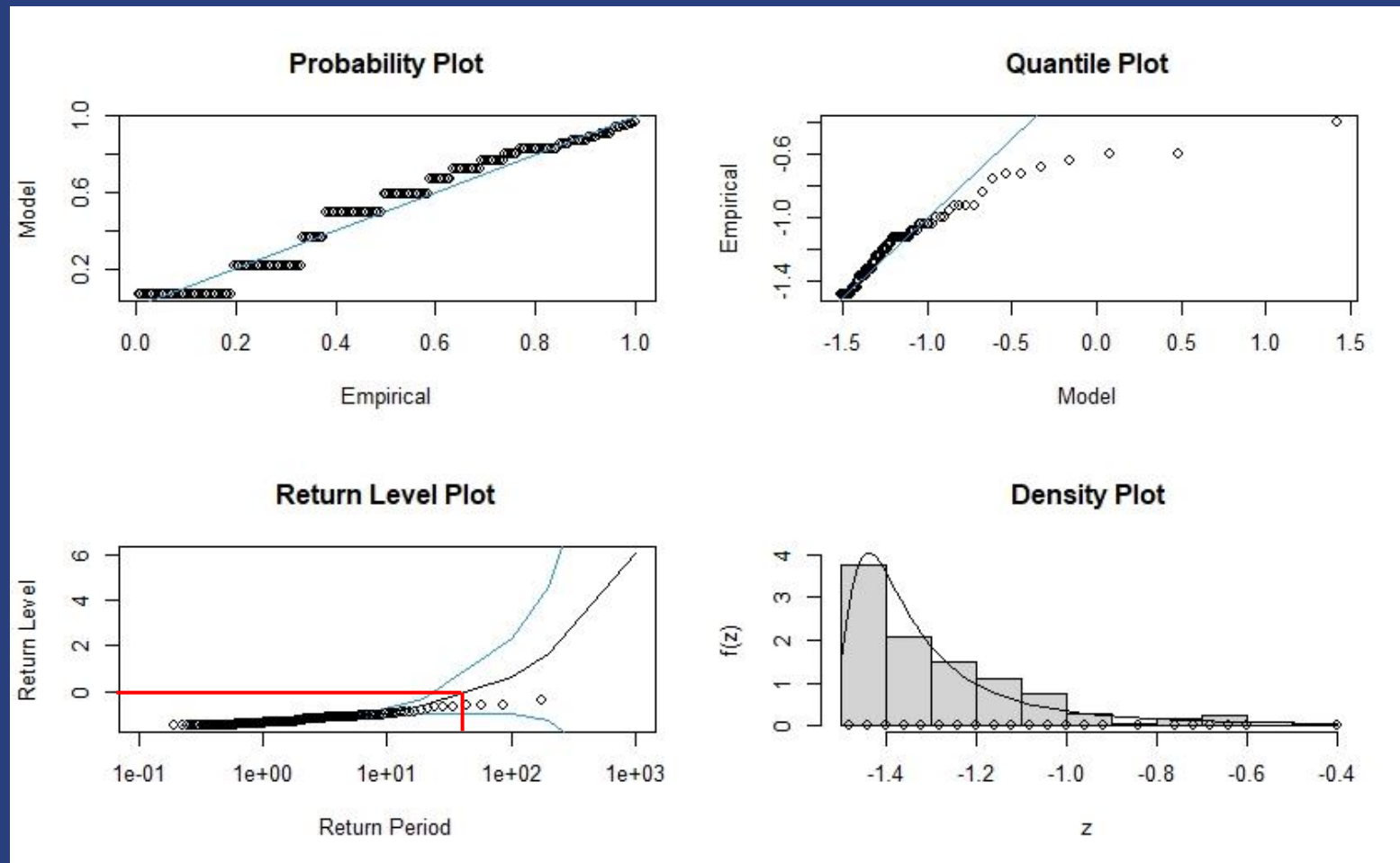
# Speed heat map



# Block Maxima (minima – negated values)

Pre-selection  $<1.5$  s ( $n=173$ )

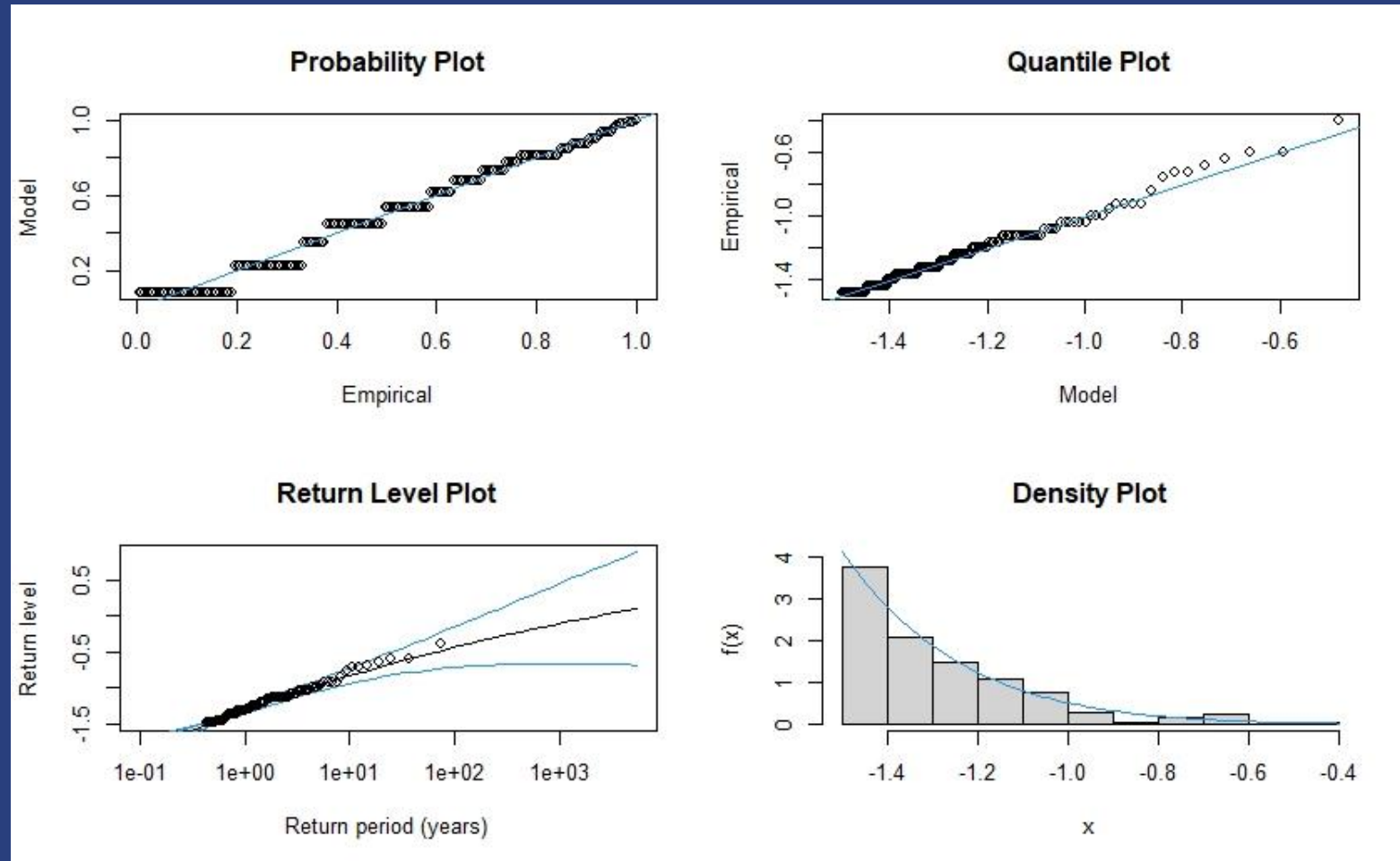
$\Pr(\text{PET}=0|\text{PET}<1.5)=0.0189$  (return period=52.98)



# Peak over Threshold

Threshold selection  $< 1.5s$  ( $n=173$ )

$\Pr(\text{PET}=0|\text{PET}<1.5) = 0.00019$  (return period=5353)



# Further investigations

BM overestimates

POT gives more reasonable results

Yet, hard to interpret crash probabilities – do we have to?

Potential research directions:

Who arrived first?

Which type of movement was it? (crossing near/far side)

Bivariate models (speed)



# Thank you for your attention!

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