A road safety assessment model for the Netherlands

A feasibility study using disaggregation by traffic mode and age

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Outline

• Introduction
• Design of the general model
• Model used in the feasibility study
• Mobility
• Risk results
• Conclusions and future research
Modelling: Why?

Data influenced by chance
Many data are available \[\rightarrow\] Filter the ‘real’ signal

Goal of a road safety assessment model:
• Interpret developments in the past
• Obtain predictions for the future
• Study the effect of road safety measures

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Scope of the model

- National data (number of victims)
- Road safety modelled in terms of risk
- Necessary input: mobility
- Factors influencing road safety e.g. age, gender, traffic mode, infrastructural properties, ....
- Safety measures
Data used

- Road safety data: number of killed and/or seriously injured
- Mobility data: from survey called MON (Mobility Research Netherlands)
- Population numbers
What is ‘a model’?

Mathematical formula: \( y = f(x_1, x_2, x_3, \ldots) \)

As an example:

- Dependent variable \((y)\): risk
- Independent variables \((x_1, x_2, \ldots)\): traffic mode, age, gender, speed limit, …

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Disaggregation (1)

- **What?**: Analysis in subgroups
- **Why?**: to be able to see if (risk)-developments are different in different subgroups
- **How?**: analyse subgroups with its interrelations

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Disaggregation (2)

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Definition of risk: single vehicle accidents

Single vehicle accidents:

\[ N = r \times M \]

where

\( N \) = number of victims
\( r \) = risk
\( M \) = mobility

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Definition of risk: two-vehicle accidents

Two vehicle accidents:

\[ N = \rho \cdot M1 \cdot M2 \]

Mobility victim \( M1 \)
Mobility opponent \( M2 \)
Risk density \( \rho \)
Victim risk \( r1 = \rho \cdot M2 \)
Opponent risk \( r2 = \rho \cdot M1 \)

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General model

Number of victims:

\[ N \approx \sum \dot{N} + \sum \ddot{N} = \sum r \cdot M + \sum \rho \cdot M \cdot M \]

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Feasibility study

- Disaggregation by traffic mode and age only
- Car and bicycle only

**Goal**: demonstrate feasibility (computability) of the model
Mobility: assumptions

• Basic idea:
  - For each traffic mode separately
  - Mobility = population number * mobility per capita
• Mobility per capita:
  - linear in time
  - smooth over ages
• Mobility per capita estimated using weighted least squares method
Mobility results: Car

Mobility per capita

Mobility

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Risk model: assumptions

- Risk ‘data’ derived from victim numbers and mobility results
- Risk for victim and opponent derived from the risk density (for two vehicle accidents)
- Risk (density) is assumed to be:
  - smooth over ages
  - exponential in time
- Risk estimated by maximum likelihood
Risk results: single car accidents

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Mobility results: bicycle

Mobility per capita

Mobility

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Risk results: bicycle-car accidents

Victim risk

Opponent risk

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Conclusions

- We obtain plausible mobility estimates
- We obtain plausible risk estimates for victim and opponent
- The risk model is numerically feasible
- Results obtained so far are a justification for applying disaggregations
Future research

• Extend model to other traffic modes and collision types
• Add other disaggregations as well
• Add statistical tests
• Use parametrizations to keep the model computable
• Incorporate safety measures
• Develop forecasting model
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