Forecasting Fatal Pedestrian Injuries Within the United States:
A Model-Based Approach
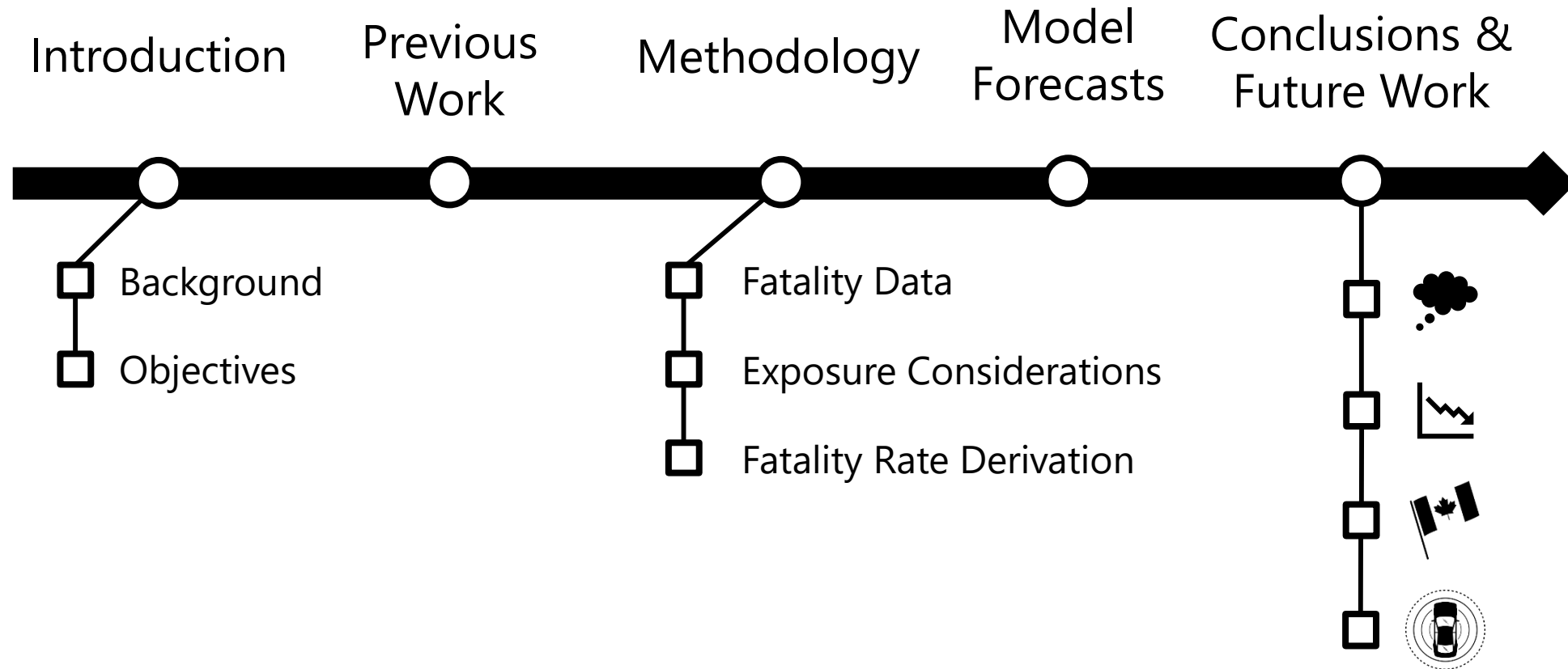
Jeff Pascua
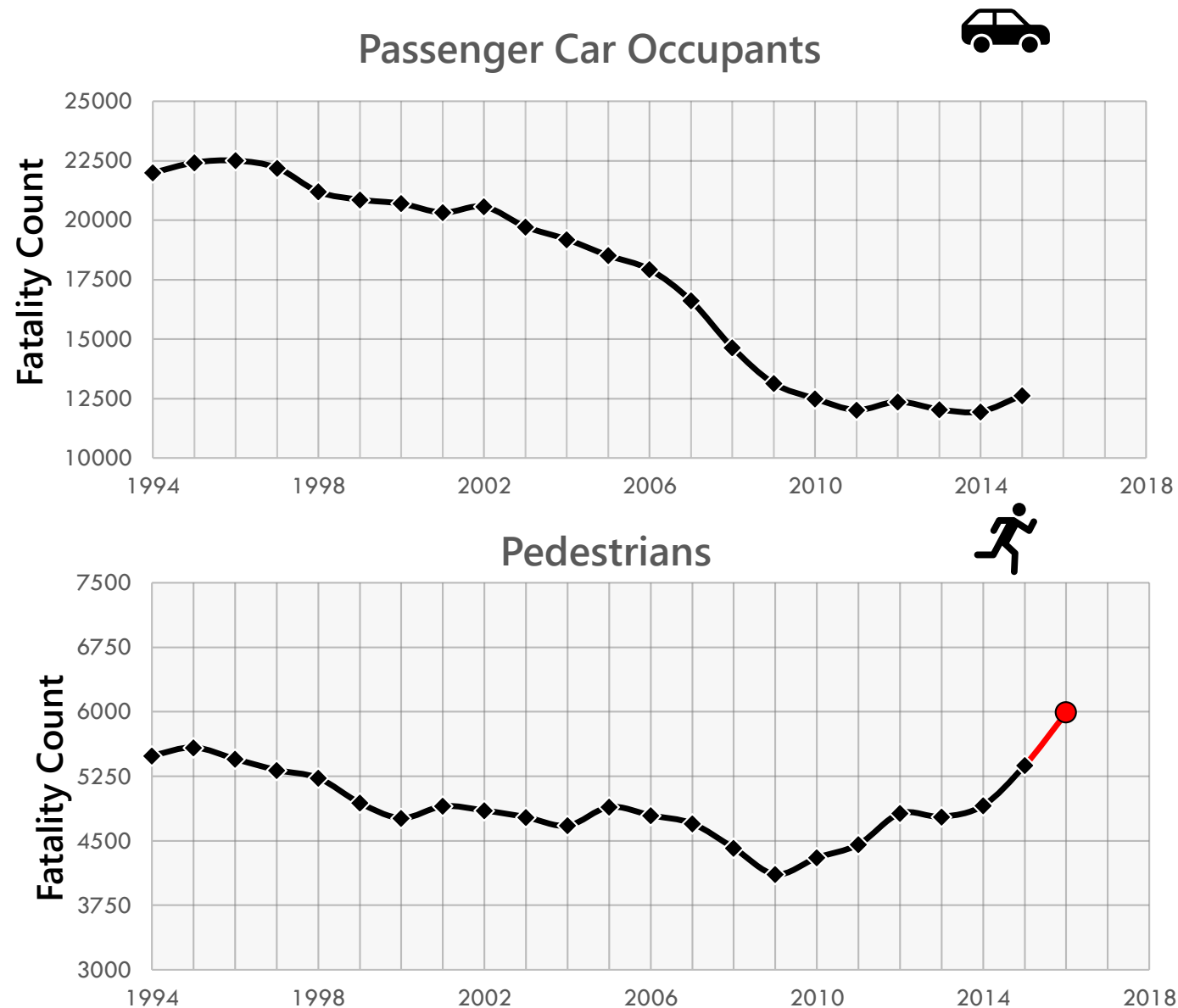
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CRSD SAFE DRIVING
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Overview

Introduction

Previous Work

Methodology

Model Forecasts

Conclusions & Future Work

- Background
- Objectives

- Fatality Data
- Exposure Considerations
- Fatality Rate Derivation

Pedestrians are the most vulnerable of all road users.

Passenger Car Occupants
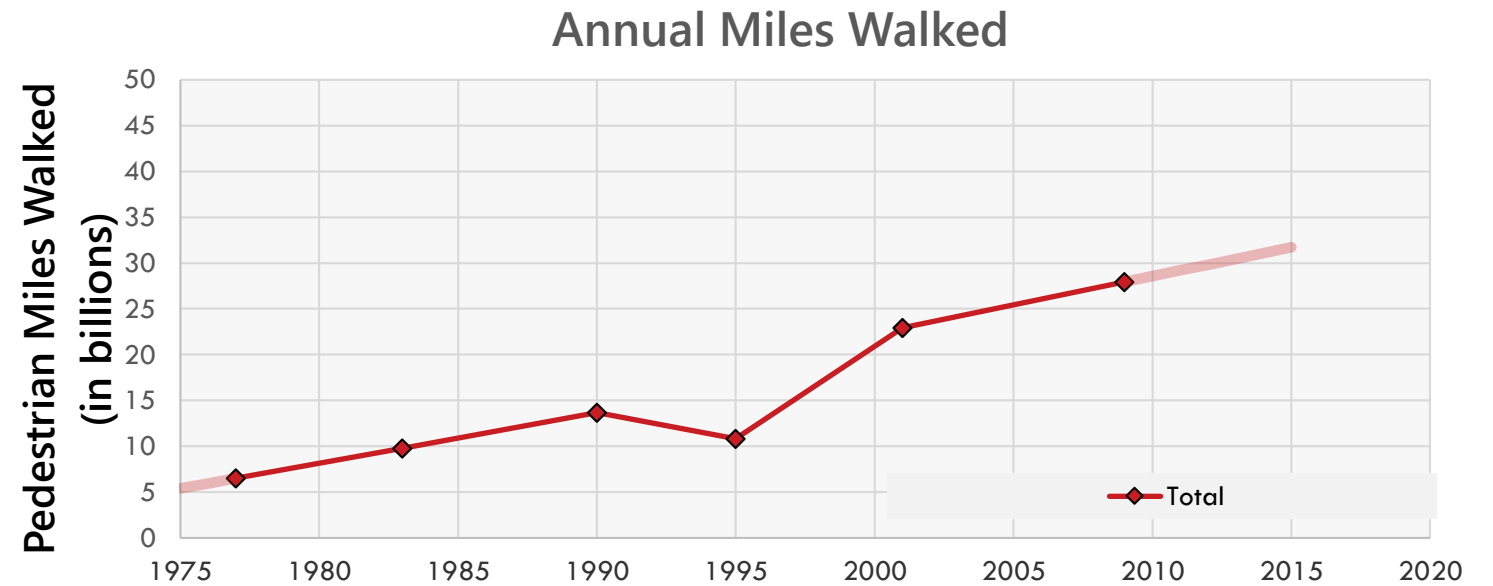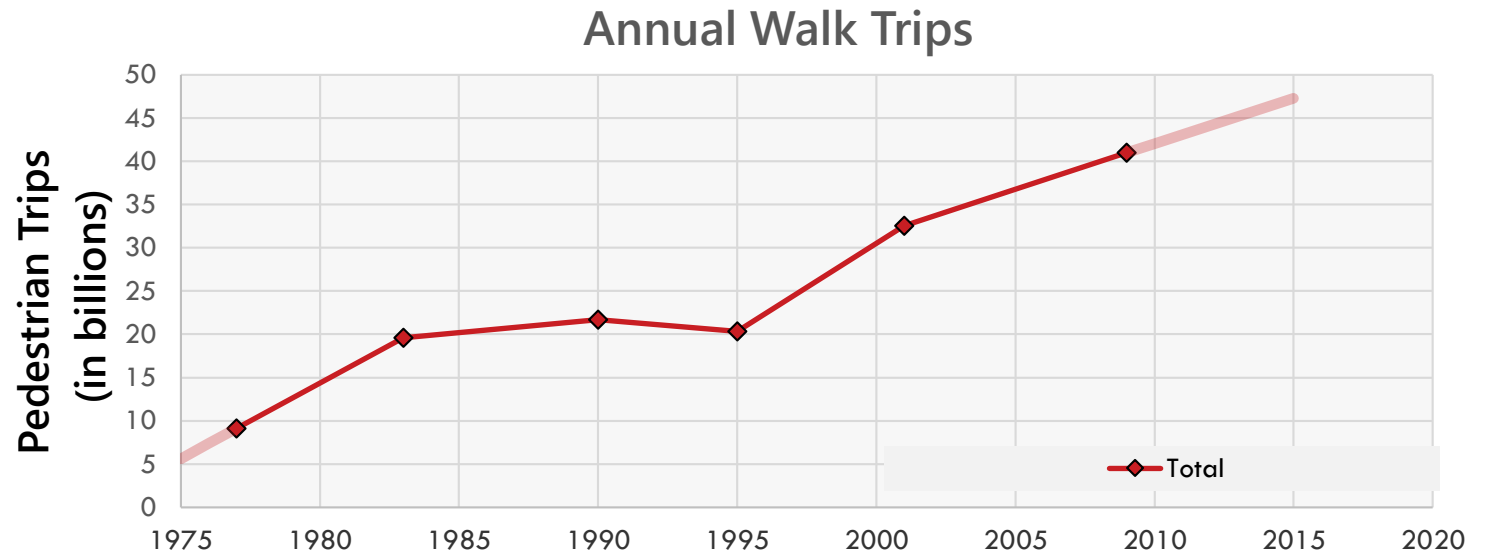
Pedestrians

Source: NHTSA Fatality Analysis Reporting System (FARS)

Figure 1: Annual U.S. Fatalities by Person Type (1994-2015).

Pedestrian activity is seemingly on the rise.

~ 20 billion walk trips- 1983.

~ 40 billion walk trips - 2009.

Annual Walk Trips

Annual Miles Walked

Source: U.S. DOT FHWA NHTS

Figure 2: Annual U.S. pedestrian travel trends (1977-2009) with linear interpolations and extrapolations.

What will pedestrian safety look like in the future?

FHWA's *Strategic Agenda for Pedestrian and Bicycle Transportation* [3]:

1. **Targets to increase AT mode share:**

   ⬆ **30%**
   2025

   "Increase the percentage of short trips represented by bicycle and walking from 20.1% (2009) to 30%..."

What will pedestrian safety look like in the future?

FHWA's *Strategic Agenda for Pedestrian and Bicycle Transportation* [3]:

2. AT injury reduction targets:

↓ **80%**
2031

a) *"Achieve an 80 percent reduction in pedestrian and bicycle fatalities and serious injuries in 15 years..."*

What will pedestrian safety look like in the future?

FHWA's *Strategic Agenda for Pedestrian and Bicycle Transportation* [3]:
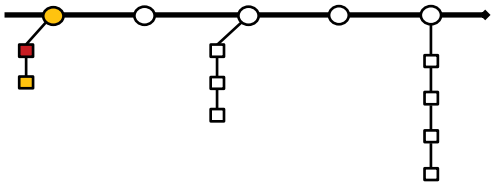
2. AT injury reduction targets:

b) "...**zero** *pedestrian and bicycle fatalities and serious injuries in the next 20 to 30 years.*"

100%

~ 2036 - 2046
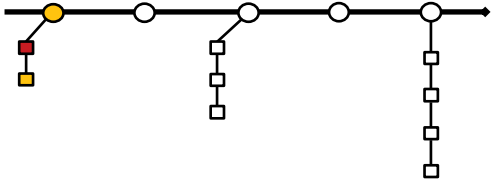
Research Objectives

To provide quantitative estimates of pedestrian safety in the coming decades.

To identify at-risk pedestrian demographics susceptible to traffic-related fatality.

Previous Work
Current State of Research

- Few forecast studies on active transportation & safety

- No standardized measure of pedestrian exposure

- Previous studies utilize macro-level predictor variables [5,6]

- VMT is changing among American millennials and baby-boomers [7, 8]
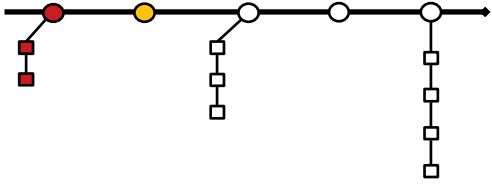
Previous Work
Setting Road Safety Targets

Three general approaches to establishing road safety targets [8]:
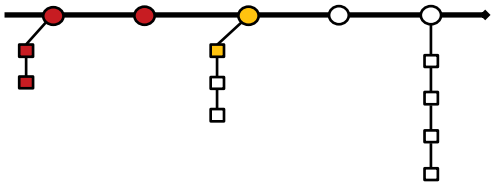
a) Aspirational

- relatively arbitrary
- limited numerical justification

b) Model-Based

- data-driven, but reliant on assumptions
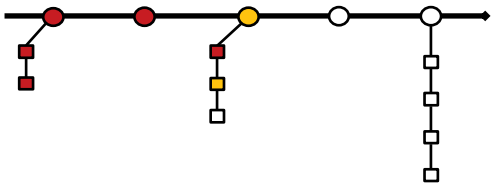- model structure dictates trend

c) Evidence-Based

- interventions are quantified and incorporated
- validation for model-based approach

Methodology
Fatality Data

- **NHTSA FARS** [1]

- reported vehicle-related crashes that:

  ❑ are on public roads,

  ❑ resulted in death of at least one road user,

  ❑ resulted in death within 30 days of crash.

Methodology
Exposure Considerations

- **FHWA NHTS** [2]

- sample-based inventory of American travel

  - ❏ demographics, trip metrics, etc.
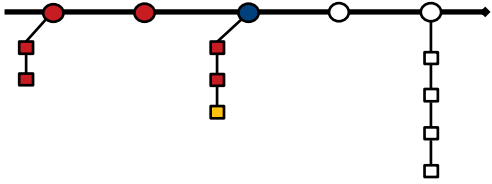
  - ❏ representative weights for national estimates
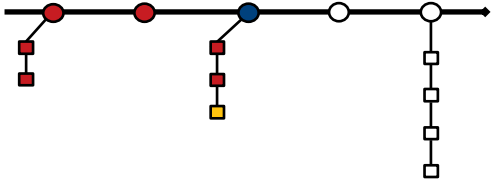
Methodology
Categorization

- **classify fatality and travel data**

- **12 age-sex cohorts**
  - 6 age groups
  - male & female

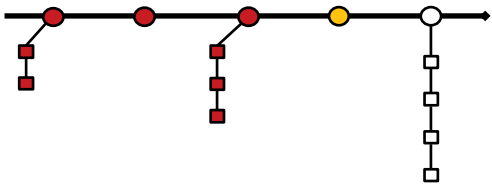model forecasts for cohorts marked with ★ are shown in next section.

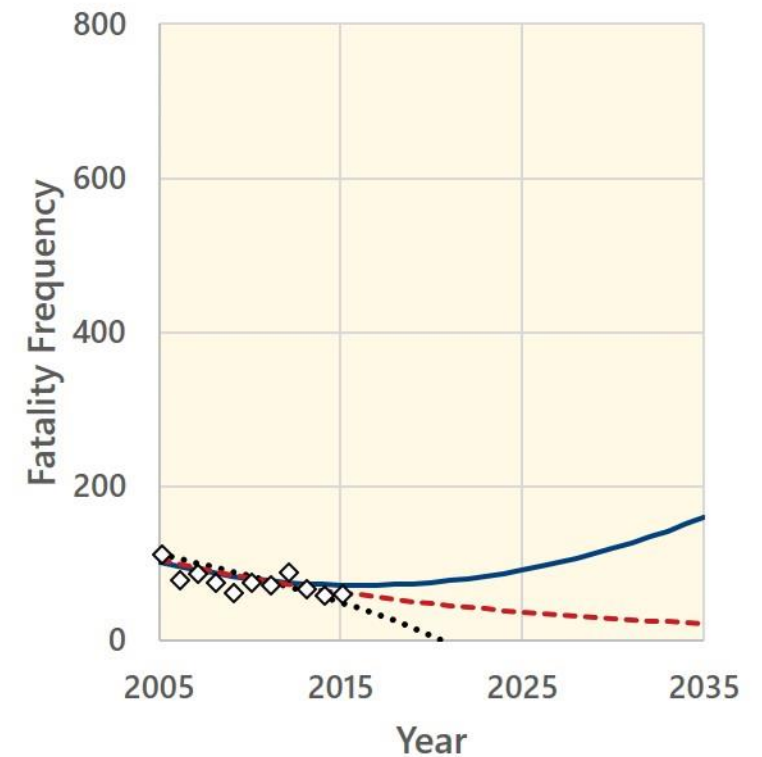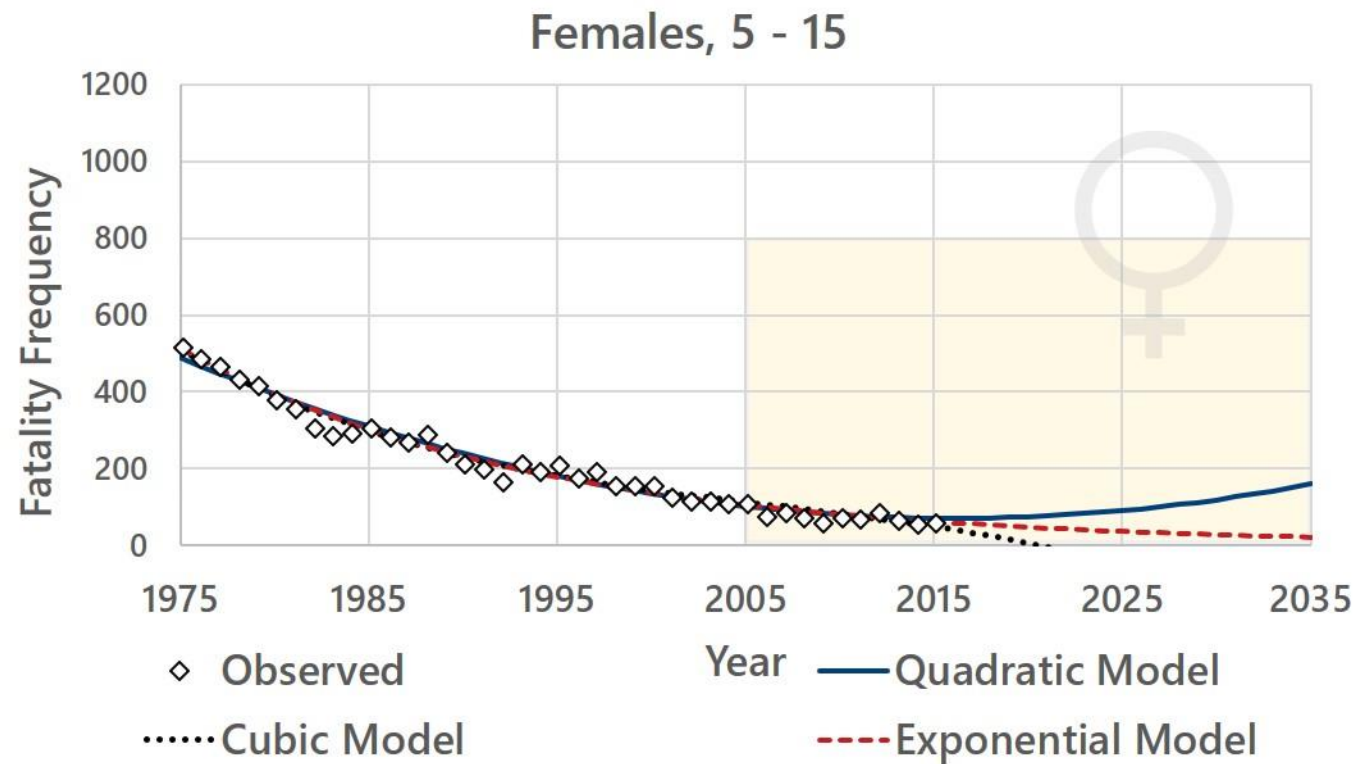| Age Group	Sex		
	Male		Female
	5 - 15	★	5 - 15
	16 – 19		16 – 19
	20 - 34		20 - 34
	35 - 54		35 - 54
	55 - 64		55 - 64
	65+	★	65+

Methodology
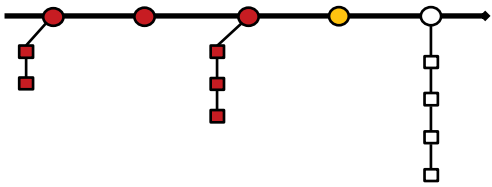## Model Forecast Structure

- **SPSS CURVEFIT Regression**

  - 11 regression models including (but not limited to):

    - Polynomials*

    - Logistic

    - Exponential / Logarithmic

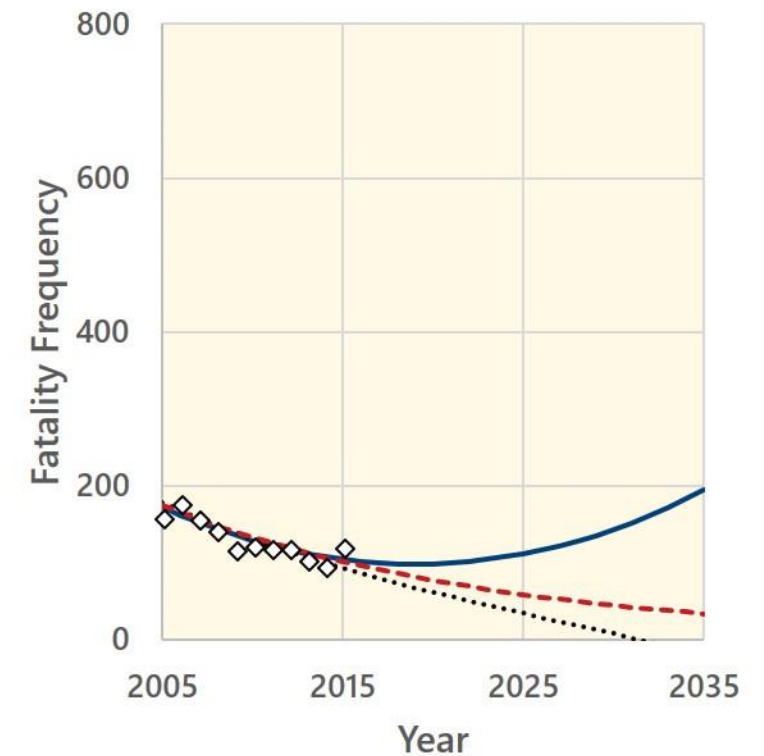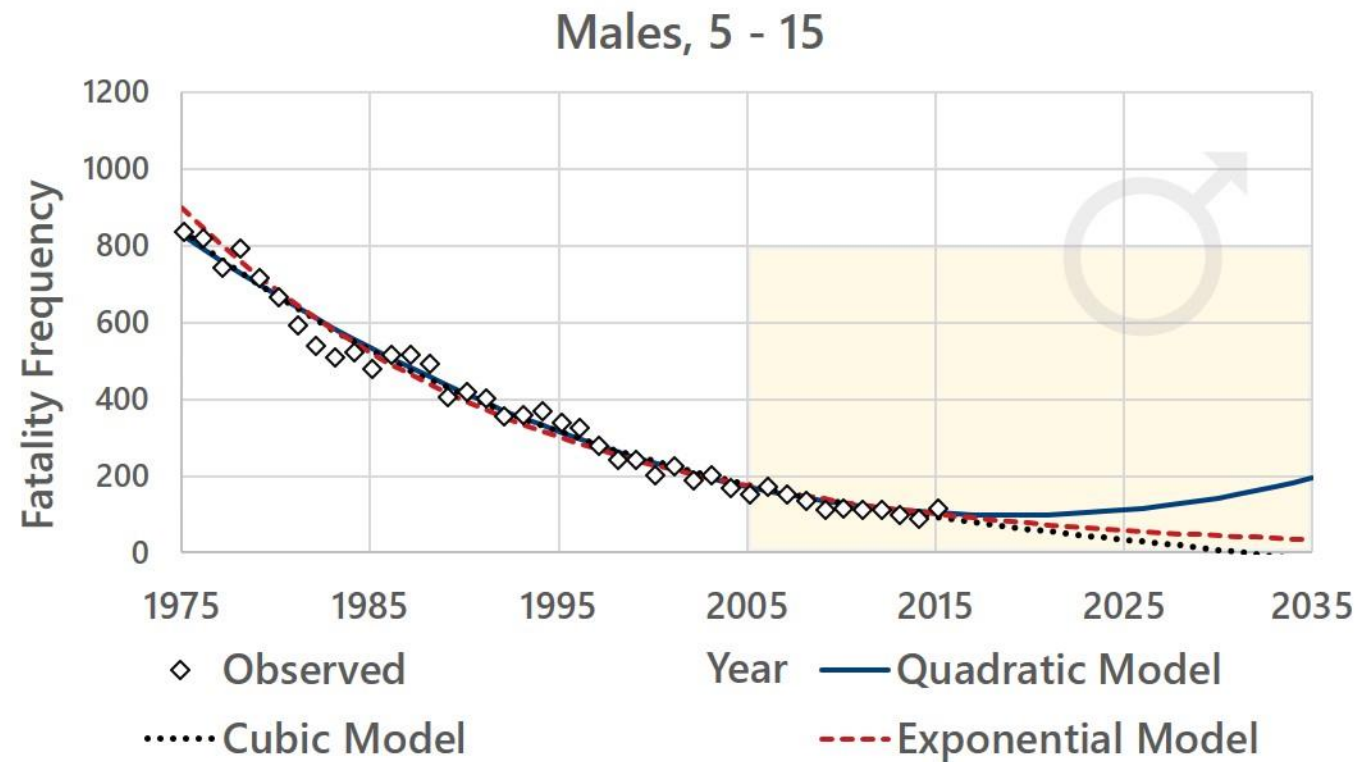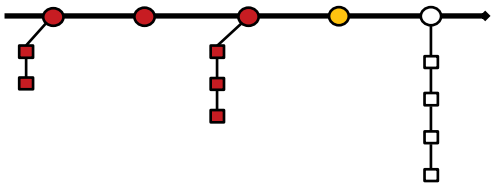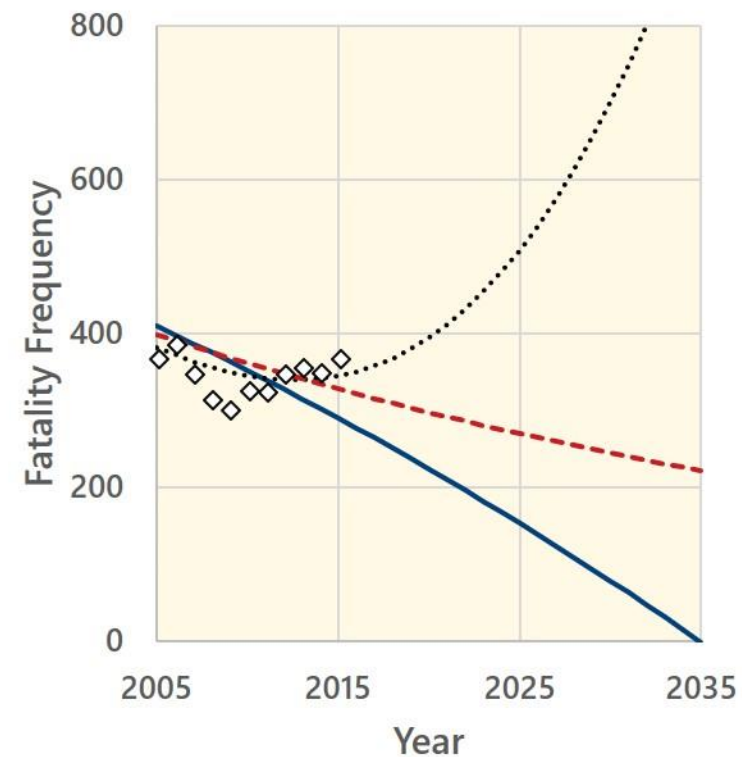- **models chosen based on AIC**

Model Forecasts
Females, Aged 5 - 15

Model Forecasts
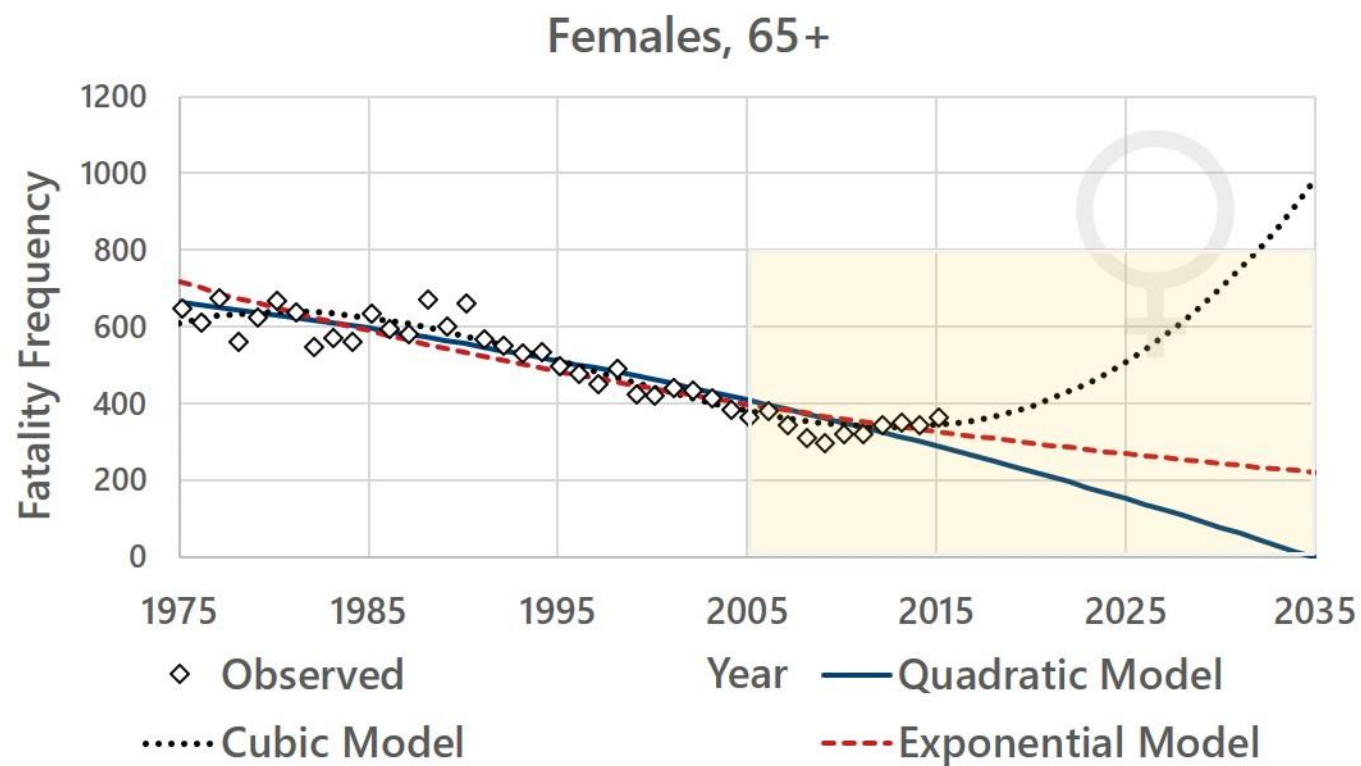## Males, Aged 5 - 15

Model Forecasts
Females, 65+

Females, 65+

Model Forecasts
Males, 65+
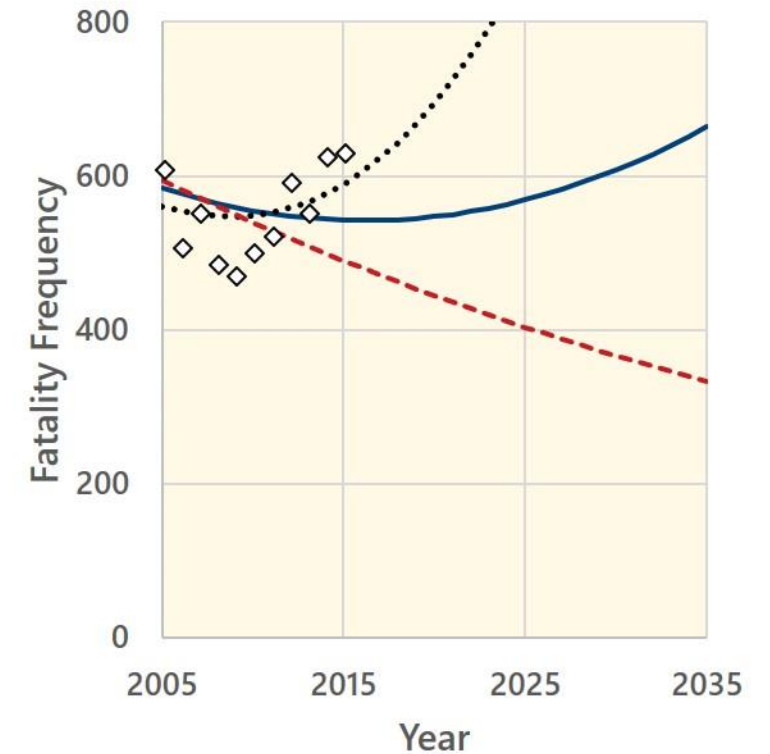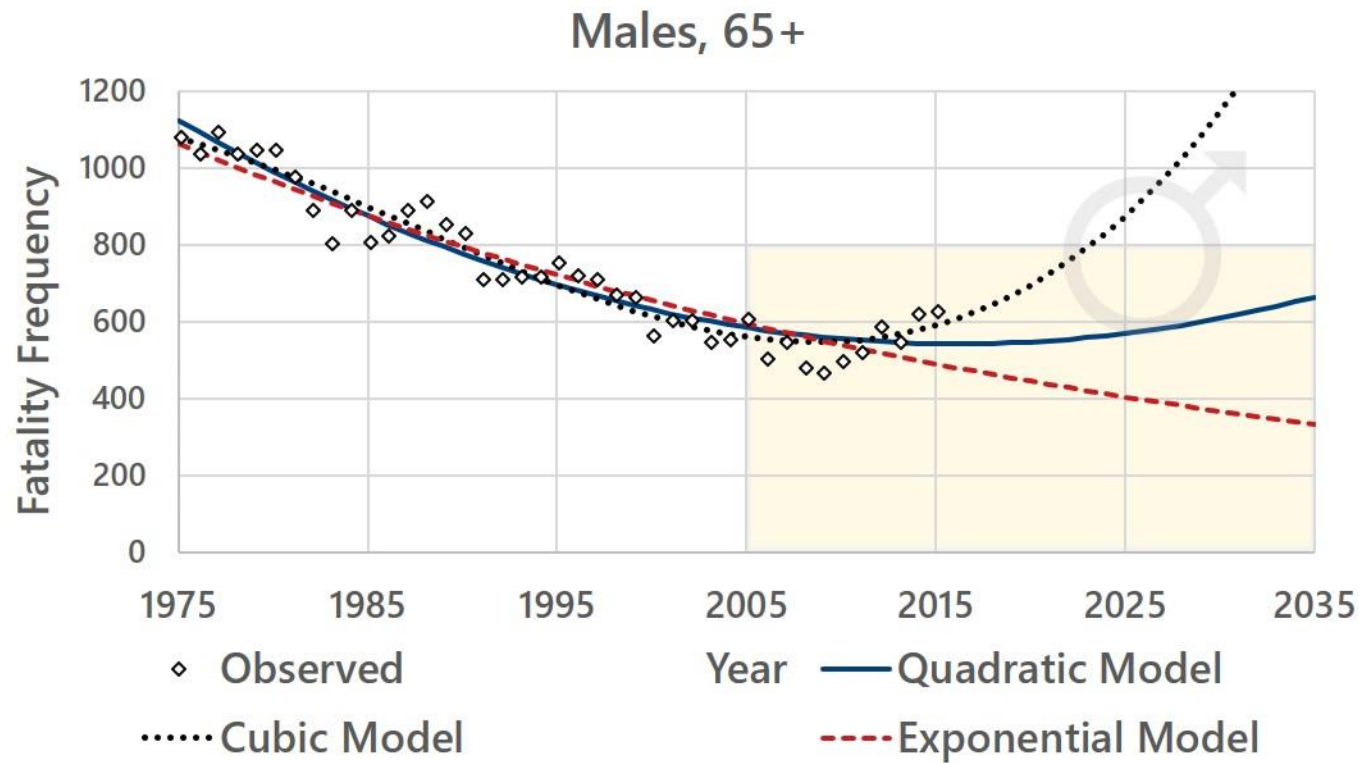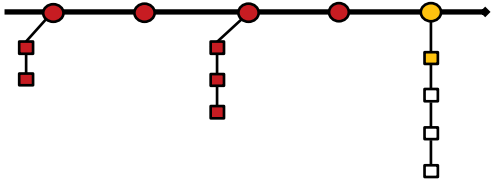
Conclusions
Key Findings from Forecasts

- Child pedestrian injuries (age 5 – 15) have been consistently declining since 1975.

  - ❑ zero fatalities for school-aged children appear possible!

- Pedestrian fatalities appear to be rising for those aged 55+:

  - ❑ inconsistencies with forecasts

- Polynomial-based forecasts:

  - ❑ have better fit metrics

  - ❑ may be misleading
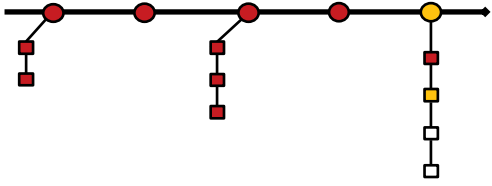
Future Work
Framework Refinement

- finding forecast consistencies using other approaches

- accounting for all severity levels

- rate-based metrics vs. absolute injury counts

- critical age?

- quantify and incorporate safety effects of policy changes
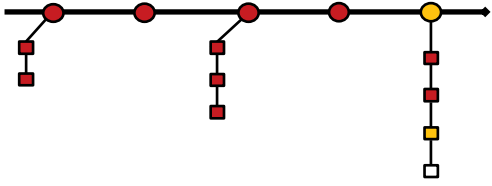
Future Work
Implementation in Canada

- **Canada's RSS 2025** [10]: no quantitative targets.

- Potential for application at sub-macroscopic geographical units:

  - Provincial / Territorial

  - Regional

  - Municipal
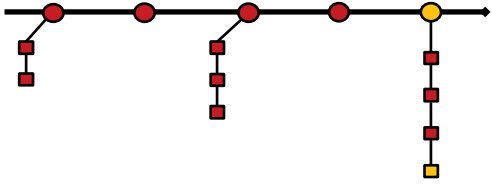
Future Work
The Influence of Emerging Technologies

How a Self-Driving Uber
Killed a Pedestrian in Arizona

By TROY GRIGGS and DAISUKE WAKABAYASHI   UPDATED MARCH 21, 2018

[11]

Forecast development should be:

collaborative

human-focused

data-driven

To improve forecast reliability, the quantity and quality of data should be improved.

Counterintuitive to want more injury data!

The objective is to reduce injuries!

Improvements in capturing travel data can be made!

Leveraging technology to gather "big data"!

References

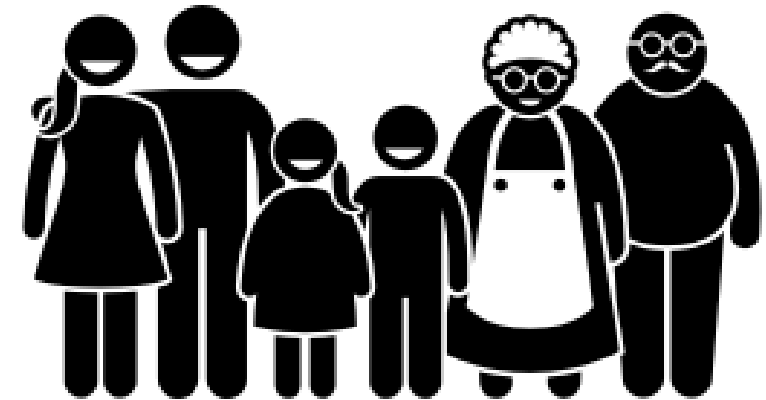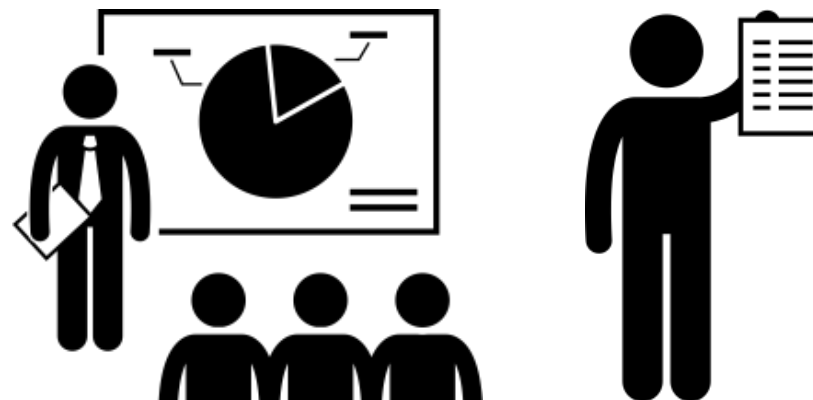[1] NHTSA. (2018). FARS Encyclopedia. Retrieved May 5, 2018, from https://www-fars.nhtsa.dot.gov/Main/index.aspx

[2] U.S. Department of Transportation, Federal Highway Administration, 2009 National Household Travel Survey. URL: https://nhts.ornl.gov.

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Questions?

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Thank you! Merci!