Road Users Protection Improvement

Capstone Project

Eric Lai

Bio

- Master of Engineering (Autonomous Systems)
- Engineer at UL (Testing, Inspection and Certification firm)
- Data science projects: Building Energy Efficiency Register Analysis
  Australian Energy Consumption Prediction
  Optimal Chess KRK-Endgame Position

Agenda

Background

Define
- Business Questions
- Data Questions
- Goals
- Definitions
- Dataset

Design
- Workflow
- Exploratory Data Analysis

Deliver
- Feature Engineering
- Modelling & Evaluation
- Outcome

Next Step

Summary

Background

In UK, over 1700 people were killed by traffic accidents every year, and hundreds of thousands injured

Number of casualties remained broadly consistent in the last 10 years

Number of accidents changed along with traffic volumes

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Business Questions

- What are the common factors that lead to road accidents?
- What is the value of saving lives?
- How to reduce the number of accidents?
- How to reduce the accident severity?

Business Questions

What is the value of saving lives?

According to economist W. Kip Viscusi, the Value of Statistical Life (VSL) in UK was $4.2 million US dollars in 2000.

Over $11 million US dollars nowadays!

Viscusi, W & Aldy, J 2003, 'The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World', Journal of Risk and Uncertainty, vol. 27, no. 1, pp. 5-76.

Data Questions

Relationship between each factor and:

- Number of Road Accidents
- Casualty Severity

What roads prompt to severe accidents?

What types of road users are more likely to get into an accident there?

Goals

Provide solutions to

- reduce number of accidents
- reduce casualty severity when a road accident happens

Definitions

Road Users:
Anyone who is using a road, such as a pedestrian, cyclist or motorist.

Reduce number of accidents:
Significantly better than last 10 years

Reduce casualty severity when a road accident happens:
Turn serious and fatal damage to slight damage

Dataset

Road Safety Data - Accidents 2019
Road Safety Data - Vehicles 2019
Road Safety Data - Casualties 2019

Source: Department for Transport
Link: https://data.gov.uk/dataset/cb7ae6f0-4be6-4935-9277-47e5ce24a11f/road-safety-data

Volume: 117536 accidents, 71 Attributes
Reliability: Very reliable
Quality: High
Data Generation: Info gathered by police
Ongoing basis: No. New report published in every September

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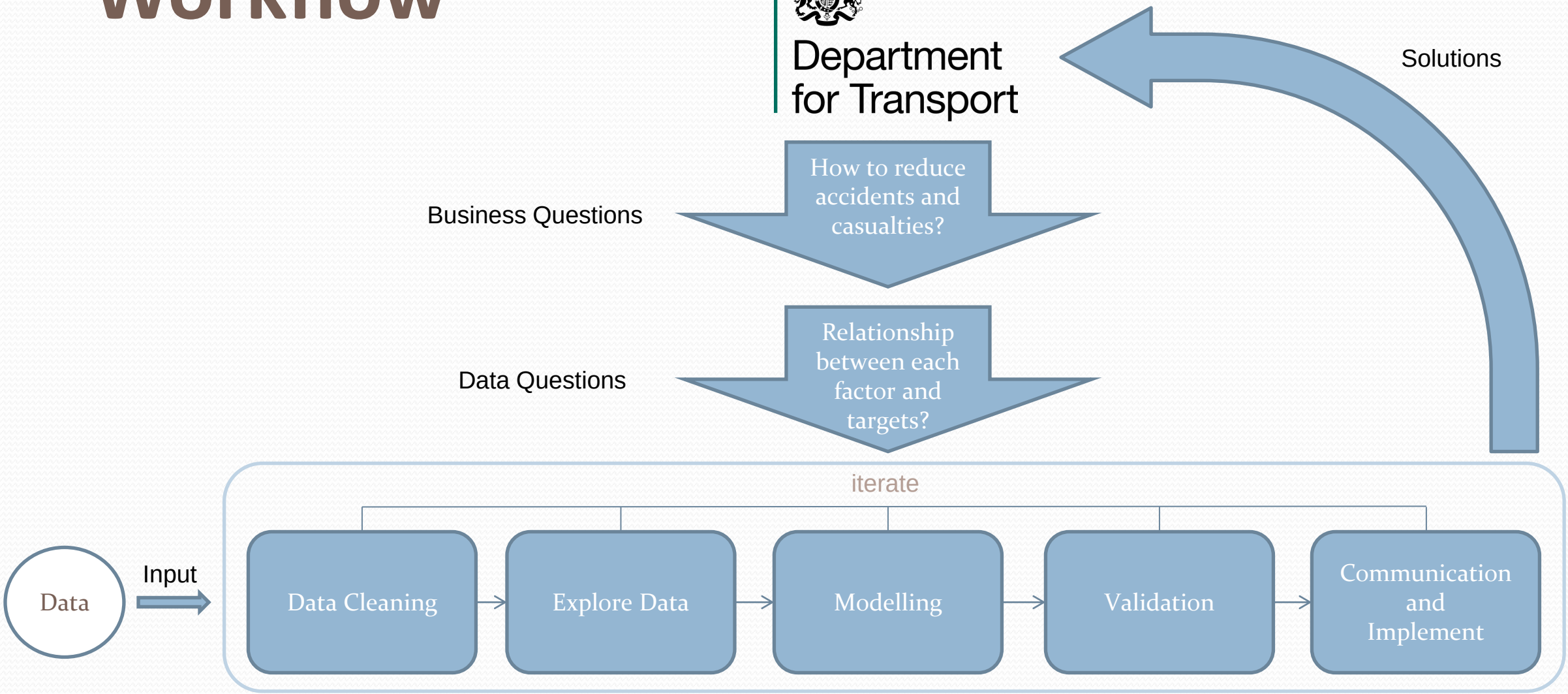
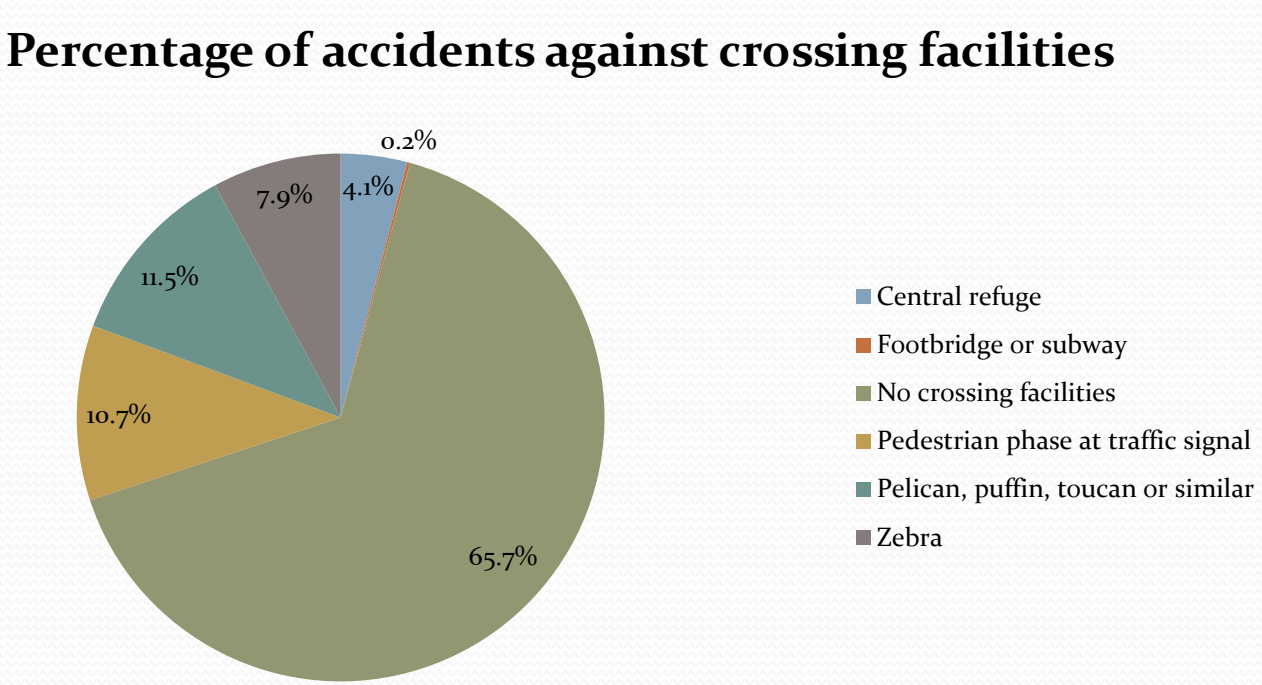
Workflow

Department for Transport



Exploratory Data Analysis

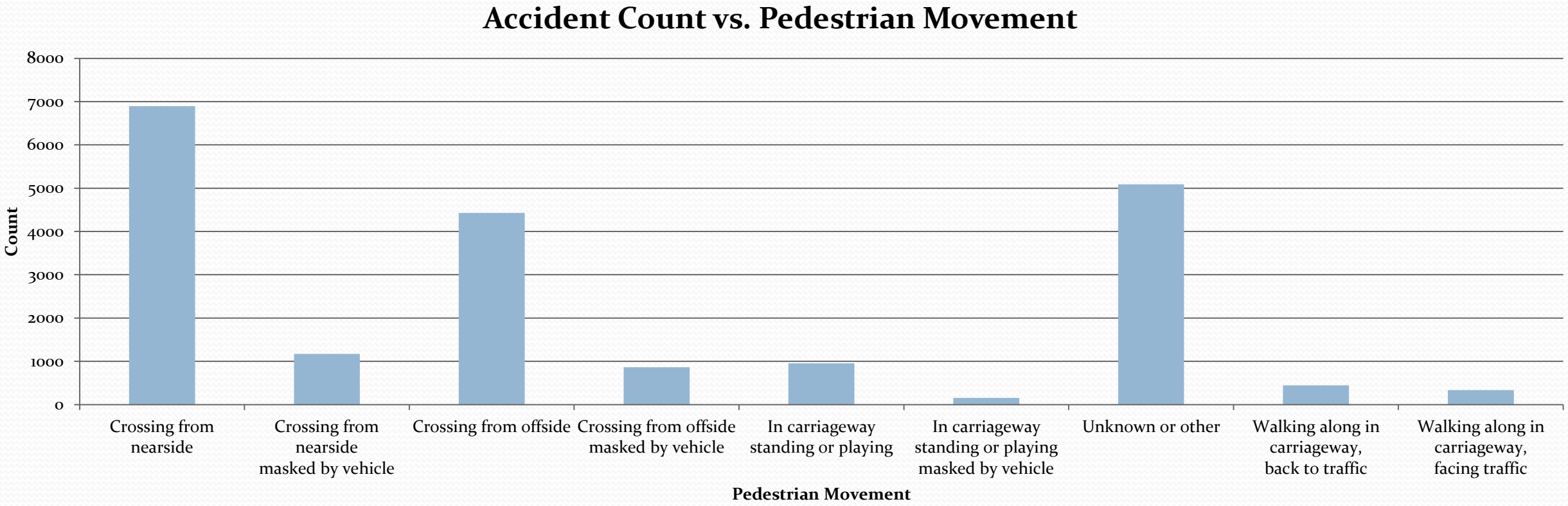
Crossing facilities can greatly reduce the chance of having an accident



Road accidents with pedestrian involved	
Central refuge	827
Footbridge or subway	36
No crossing facilities	13354
Pedestrian phase at traffic signal	2180
Pelican, puffin, toucan or similar	2330
Zebra	1604

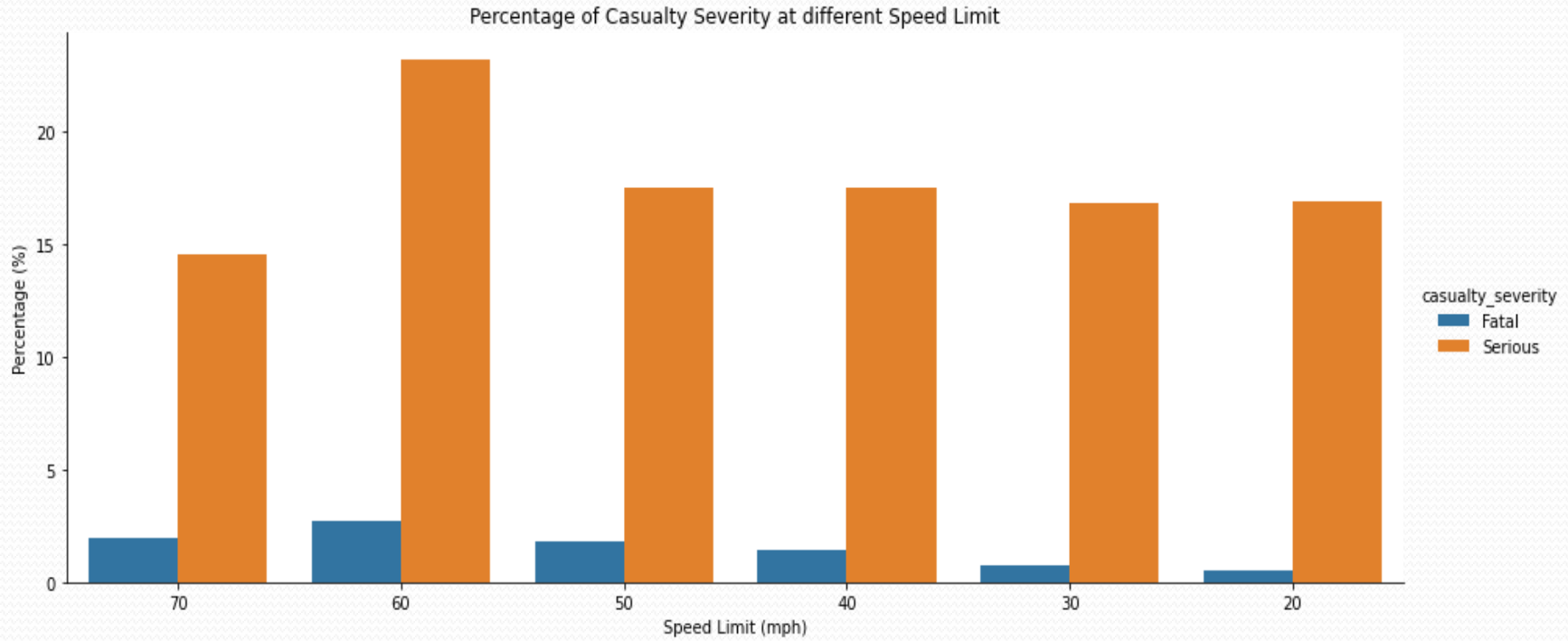
Exploratory Data Analysis

Less accidents when road users are alert



Exploratory Data Analysis

Speed Limit directly affects the rate of having serious / fatal damage during an accident. By reducing speed limit from 60 mph (96.6 kph) to 50 mph (80 kph), the chance of severe casualty will be lowered by **6.6%**.



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Feature Engineering

What roads prompt to severe accidents?

What types of road users are more likely to get into an accident there?

Features:

- Road Class
- Road Type
- Speed Limit
- Junction Detail
- Junction Control
- Crossing Facilities
- Light Conditions
- Weather Conditions
- Road Surface Conditions

Important Features:

- Speed Limit
- Crossing Facilities
- Junction Detail
- Road Type
- Road Class
- Road Surface Conditions

Modelling & Evaluation

Supervised Classification (multi-class) Models:

Decision Tree

Random Forest

Extra Trees

Ada Boost

LightGBM

K-Nearest Neighbors

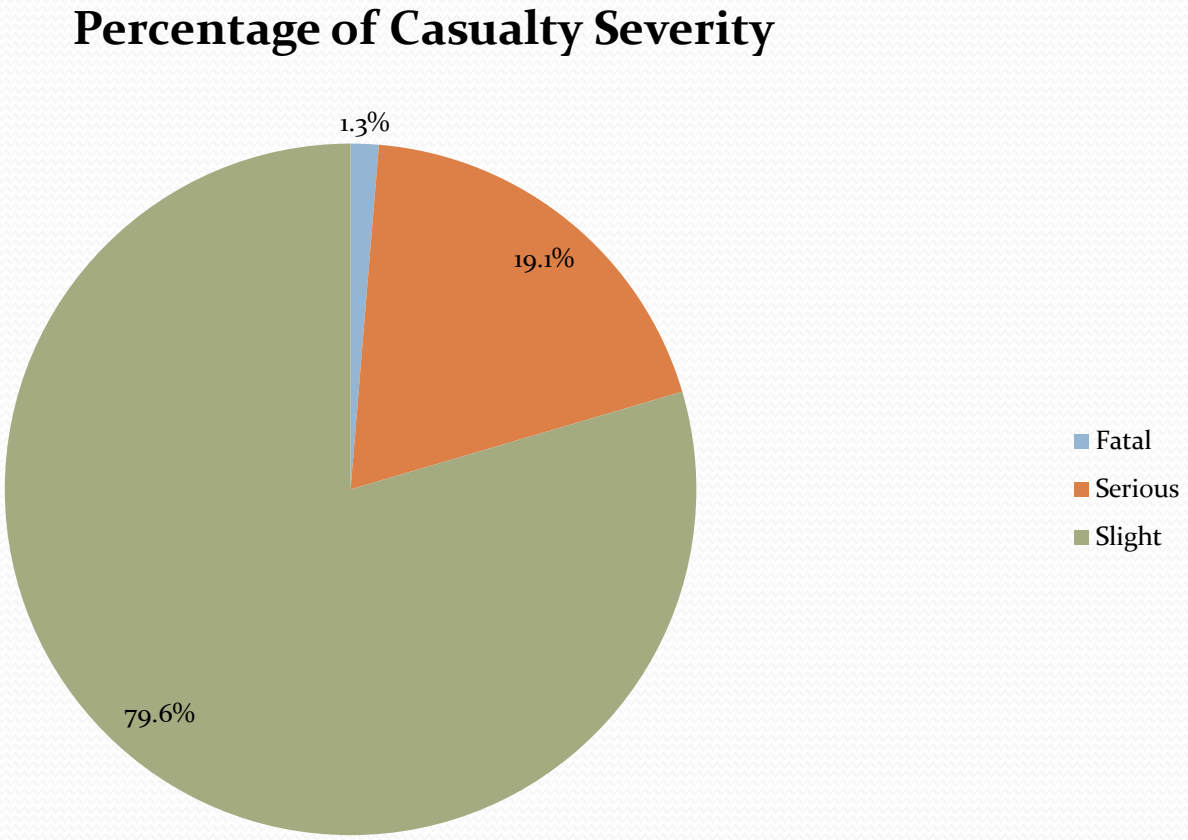
Modelling & Evaluation

What roads prompt to severe accidents?

Baseline accuracy is 79.56%

	Accuracy (%)	Process Time (s)
decision tree	79.80	0.009
random forest	79.80	1.138
extra tree	79.80	0.426
ada boost	79.80	2.084
light gbm	79.80	0.573
k-nearest neighbors	79.80	3.929

Modelling & Evaluation



Modelling & Evaluation

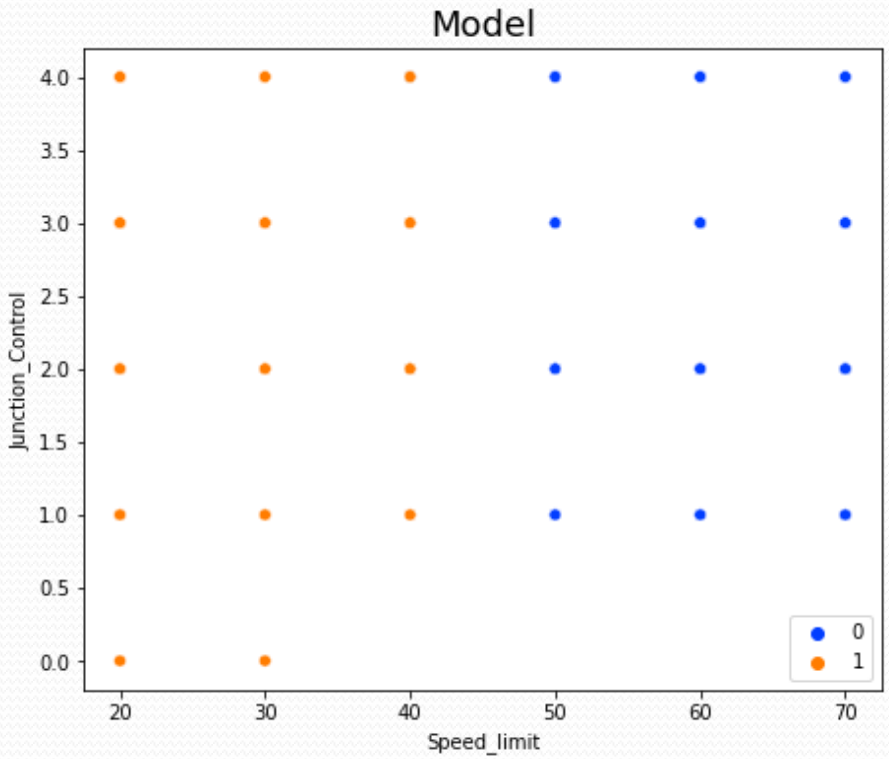
What types of road users are more likely to get into an accident?

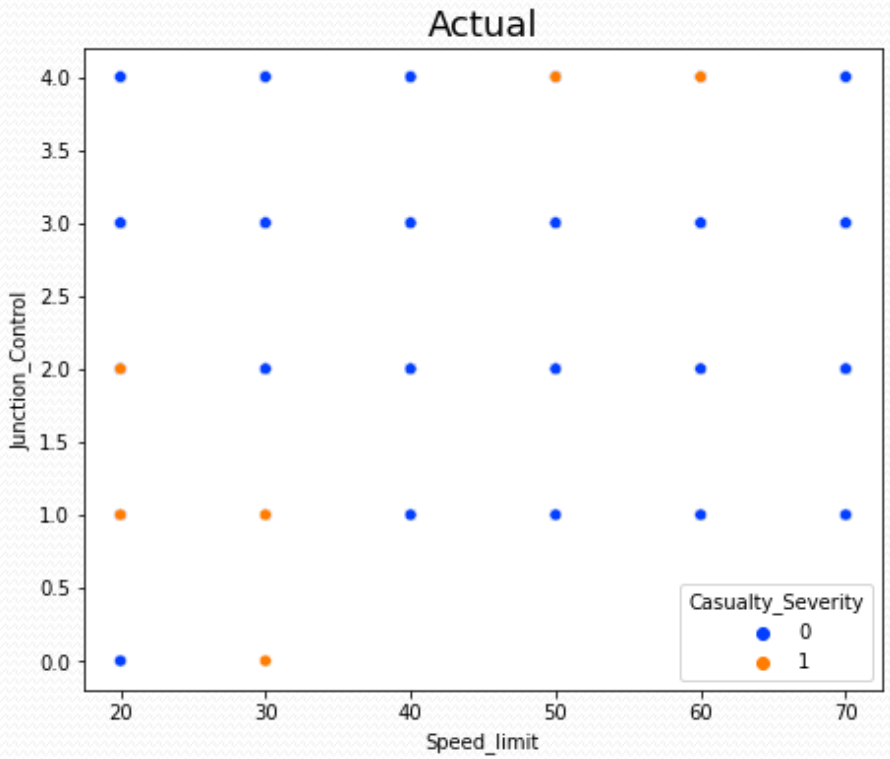
Baseline accuracy is 49.84%

	Accuracy (%)	Process Time (s)
decision tree	51.31	0.083
random forest	51.46	2.651
extra tree	51.38	0.793
ada boost	33.43	7.188
light gbm	51.47	5.577
k-nearest neighbors	51.08	2.924

Modelling & Evaluation

K-means Clustering Model





Outcome

Build sufficient suitable crossing facilities for pedestrians

Variable Speed Limit (VSL) can be a good way to improve road safety

Example: South Eastern Freeway in Adelaide

Posters and public transport advertisement can be a good reminder of appropriate manner to road users

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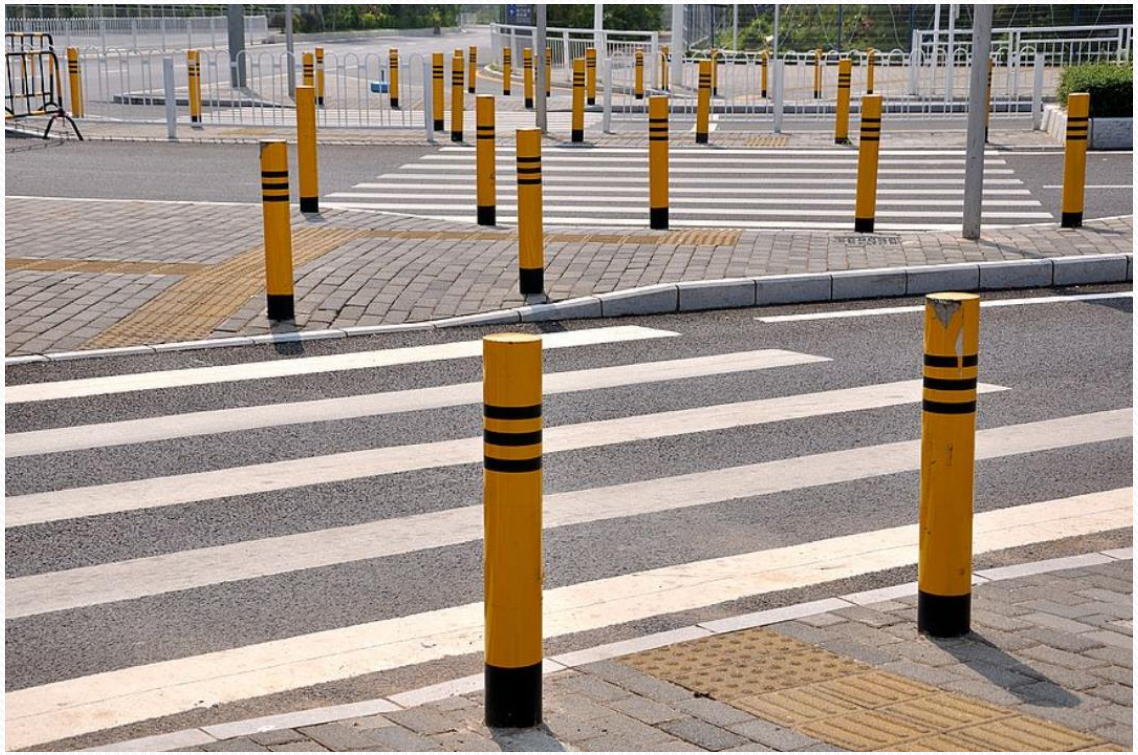
Evaluate the current crossing facilities to improve usage rate



Summary

- Pedestrian suffers the most serious damage, make sure to build enough suitable crossing facilities
- Control speed limit according to the road condition
- Educate road users on good driving habits and road manners

THE END