Predict Death by Auto Accident

By Partha Ray

1. Goal(Frame the Problem):

Predict Death or No Death with a measure of confidence given an arbitrary sample and identify the most relevant features

1.1 Initial Evaluation of potential value of said project if implemented

- Why pursue THIS particular project?
  - Human life so valuable -> INVALUABLE!
- Metric to optimize?
  - Performance Metric for chosen best ML model
    - Random Forest Accuracy Score
  - Most relevant features
    - Random Forest Feature Importances Attribute

Delving into the Data Science Process

2. Collect raw data needed for problem

The Raw Data consists of:

- Plethora of parameters which contribute to severity of road accidents in France 2205-2016
- 4 different data sources
  - Caracteristics
  - Users
  - Vehicles
  - Places
- CSV file format
- 3 million samples
- 52 parameters/sample
- Kaggle Dataset :
  - https://www.kaggle.com/ahmedlahlou/accidents-in-france-from-2005-to-2016/home

3. Process the data for analysis

The Dataset consists of :

- 52 columns
- 3,553,976 rows

Dimensions in Characteristics category

- Accident ID
- Day of Accident
- Month of Accident
- Year of Accident
- Time of Accident
- Lighting Conditions
- Department
- Municipality
- Localisation(congestion level)

Dimensions in Characteristics Category (con’t.)

- Type of Intersection
- Atmospheric Conditions
- Type of Collision
- Postal Address
- GPS Coding
- Geographic Coordinates

Dimensions in Places category

- Road Category
- Road Number
- Numeric Index Route
- Alphanumeric Index Road
- Traffic Regime
- Total Traffic Lines
- Reserved Lane Existence
- Road Gradient
- HomePRNumber

Dimensions in Places category (con’t.)

- PR Distance
- Lane Structure
- Central Lane Width
- Outer Lane Width
- Surface Condition
- Infrastructure
- Situation of Accident
- School Point

Dimensions in Users category

- Vehicle Identification
- Place
- User Category
- Sex of User
- User Year of Birth
- Trip Reason
- Safety Equipment
- Location of Pedestrian
- Action of Pedestrian
- Pedestrian Group

Dimensions in Vehicle Category

- Flow Direction
- Vehicle Category

4. Explore the Data

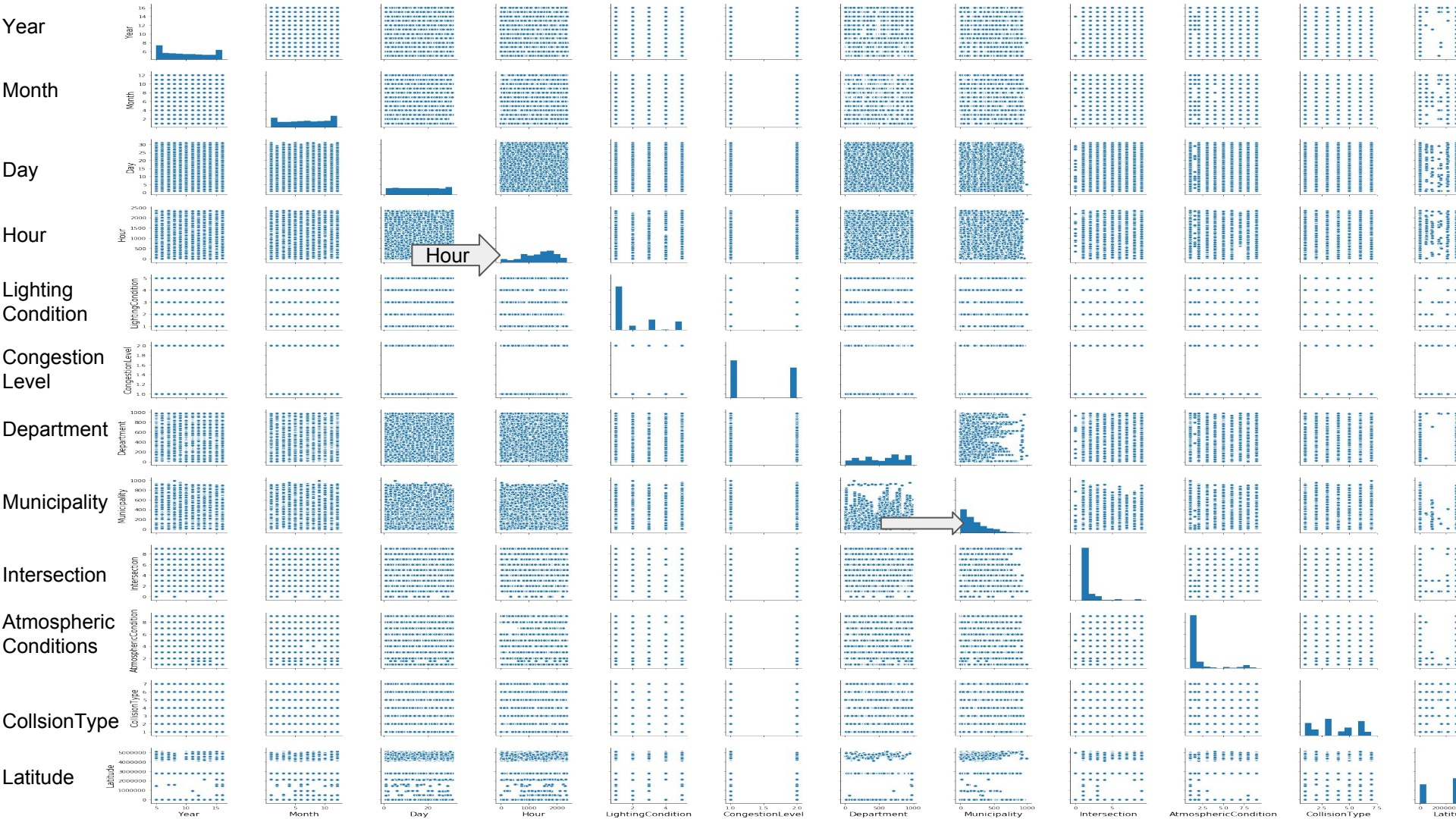
Y outcome parameter class imbalanced?

- 3,471,825 accidents resulted in NO death
- Majority class: 3 million

- 82,151 accidents resulted in a death
- Minority class: mere 82,000

Class imbalanced -> downsample due to bigger initial dataset of 3 million

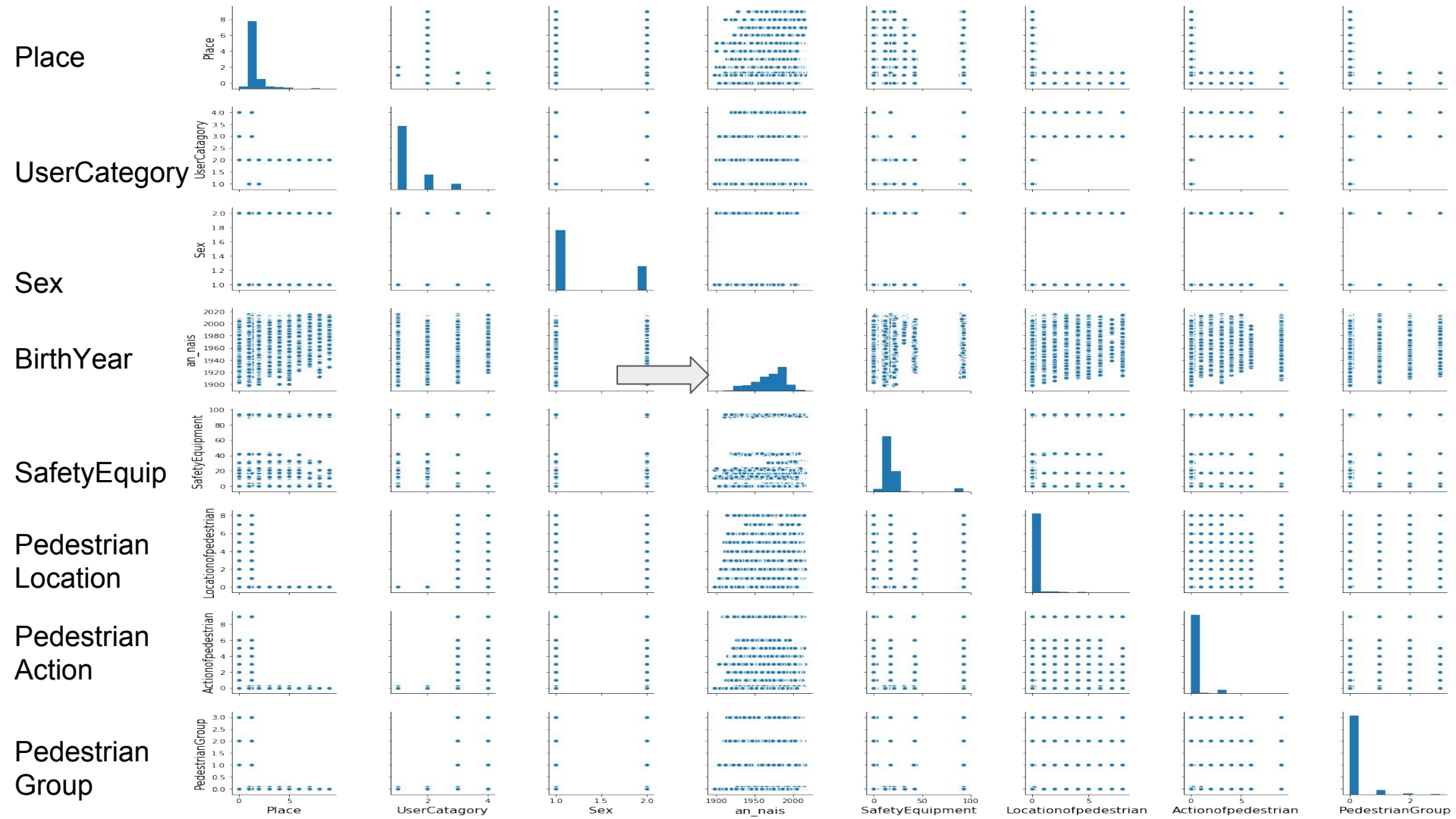
Frequencies
&
Distributions
of
Characteristics' Features


Year
Month
Day
Hour
Lighting Condition
Congestion Level
Department
Municipality
Intersection
Atmospheric Conditions
CollsionType
Latitude
Hour

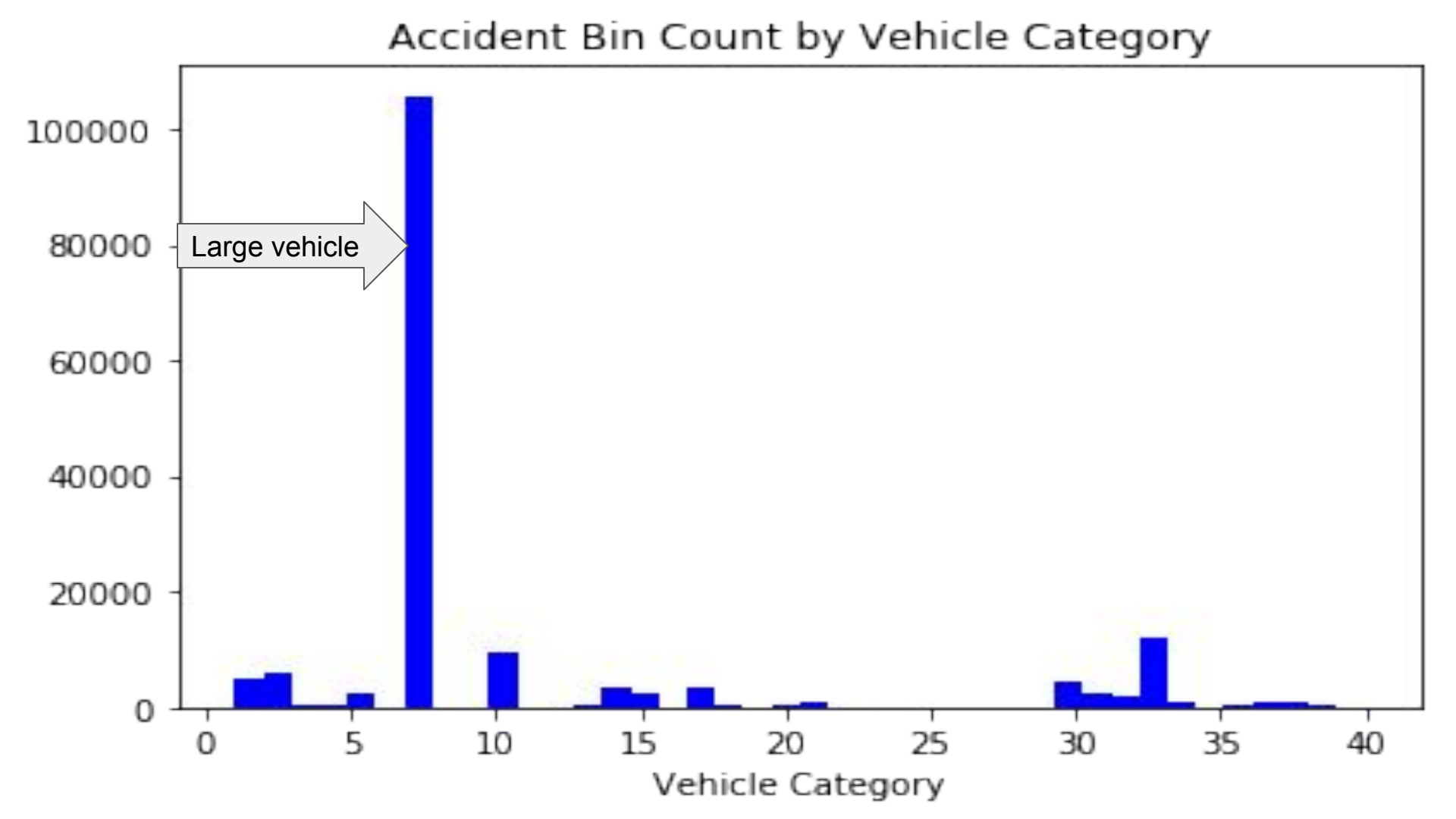
Frequencies
&
Distributions
of
Places' Features


RoadCategory
TrafficType
NumofLanes
OuterLane
gradient
HomePR Number
PRDist
LaneStruc
CentralLane Width
OuterLane Width
SurfCond
Infrastructure
Situation
nearSchool
RoadCategory
TrafficType
NumberofLanes
OuterLane
prof
HomePRNumber
PRDistance
LaneStructure
CentralLaneWidth
OuterLaneWidth
SurfaceCondition
Infrastructure
SituationofAccident
SchoolPoint

Frequencies
&
Distributions
of
Users' Features


Place
UserCategory
Sex
BirthYear
SafetyEquip
Pedestrian Location
Pedestrian Action
Pedestrian Group
Place
UserCatagory
Sex
an_nais
SafetyEquipment
Locationofpedestrian
Actionofpedestrian
PedestrianGroup

Frequency visualization
of
Vehicles' Feature


Accident Bin Count by Vehicle Category
100000
80000
60000
40000
20000
0
Large vehicle
0
5
10
15
20
25
30
35
40
Vehicle Category

Delve into Dimension Reduction -> smaller set of Relevant Features

Drop seemingly Irrelevant Features

- AccidentID
- Department
- Municipality
- Road Number
- Numeric Index Route
- Alphanumeric Index Road
- Home PRNumber
- PRDistance
- Vehicle Identification
- Place

Intuitive dropping (con’t.)

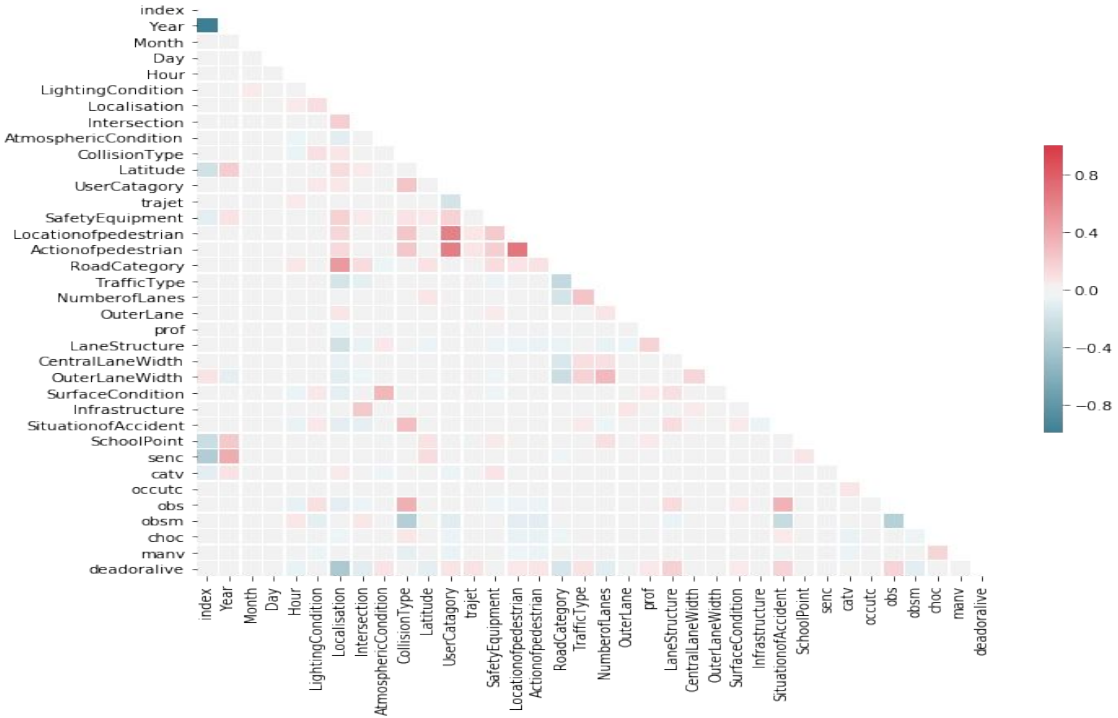
- Sex
- User Year of Birth
- Trip Reason
- Pedestrian Group
- Flow Direction

How big is the data set now?

- Columns: 37
- Rows: 164302

Normalize dataset -> machine learning models can better learn & utilize

Visualize correlations among features



- Very low , non existent correlations
- Action of pedestrian, pedestrian group, location of pedestrian are the exceptions

PCA works best when:

- Features normally distributed
- Linear relationship among features
- Correlation among features weak -> moderate

LAST TWO ASSUMPTIONS ARE NOT MET MOST LIKELY DUE TO HEAVY CATEGORICAL PRESENCE -> STATSMODEL OLS FUNCTION -> FURTHER DIMENSION REDUCTION

Statsmodel ols function -> features to drop with > .05 pvalue:

- Month 1.108377e-01
- Day 4.787969e-01
- Occutc 1.443713e-01
- choc 6.286442e-01

How big is the data set now:

- Columns: 32
- Rows: 164302

Even further Dimension Reduction -> Random Forest Feature Importances :

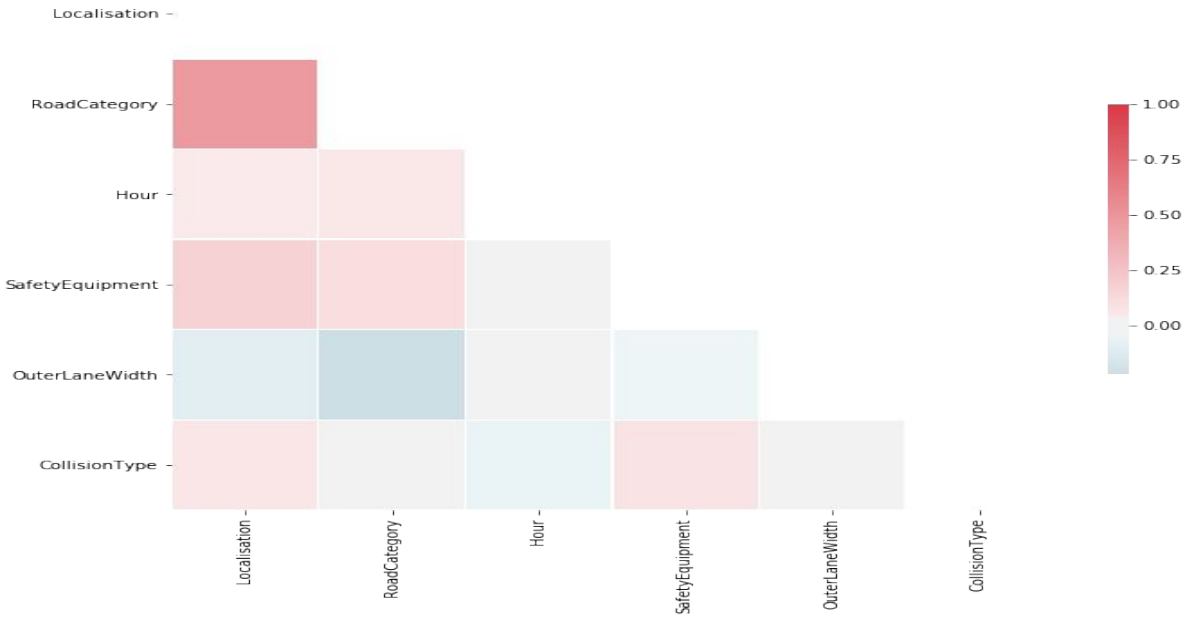
Extract most relevant features:

- Localisation : .082
- Road category: .073
- Hour : .072
- Safety Equipment: .063
- OuterLaneWidth: .060
- CollisionType: .049

How big is the dataset at this point:

- Columns: 6
- Rows: 164302

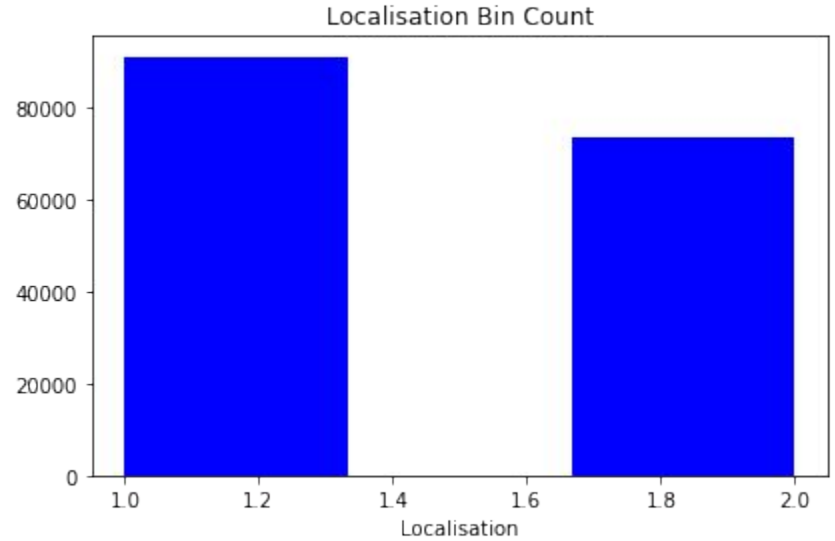
Visualize correlations among dimension again:



- No further dimension reduction via PCA because non linear relationship among features

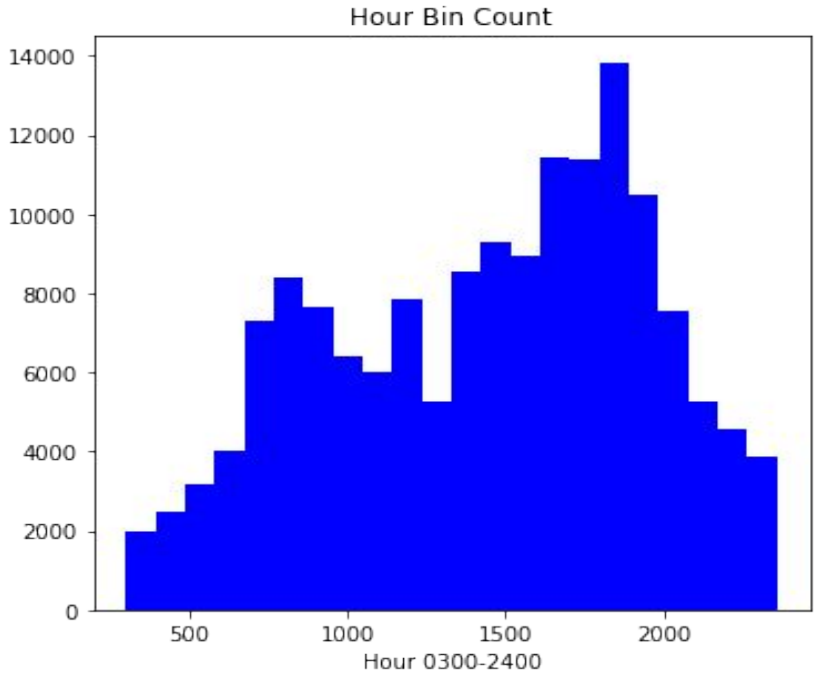
Look more Closely at the Distributions & Frequencies of the relevant features:

Localisation



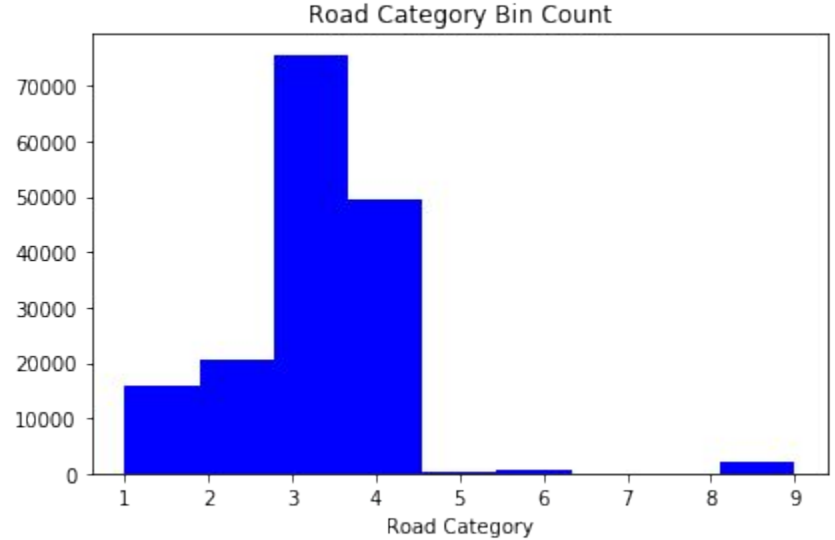
- First bar -> less congested traffic
- Second bar-> heavy traffic congestion
- Counter intuitive -> heavy traffic congestion resulted lower accident count

Hour



- Bimodial distribution
  - 8am : accident count 8000
  - 7pm: accident count 13000
- Indicative of two normal gaussian distributions

Road Category



- Bars increasing -> roads become more local from highway to parkinglot
- Accident count highest for departmental roads

5. Perform In-depth analysis (Modeling, Training, Validating, Testing)

6. Communicate the results of the analysis (data product)

Comparing Accuracy Scores on different models

	acc_sc_val	acc_sc_test
NBC	.694	.694
KNN_C	.741	.747
DTC	.733	.735
RFC	**.779**	**.785**
GBC	.761	.762

- All ml classification model accuracy scores' has higher/same test scores than validation scores -> no overfitting due to low variance

Best Performing Model: RFC Classifier

PROS:

- Ensemble model -> low variance -> avoids overfitting
  - Test set acc sc > validation set acc sc
- Low bias -> avoids underfitting
  - Relatively high validation & test set acc scores
- Most significant features
  - RFC feature importances attribute

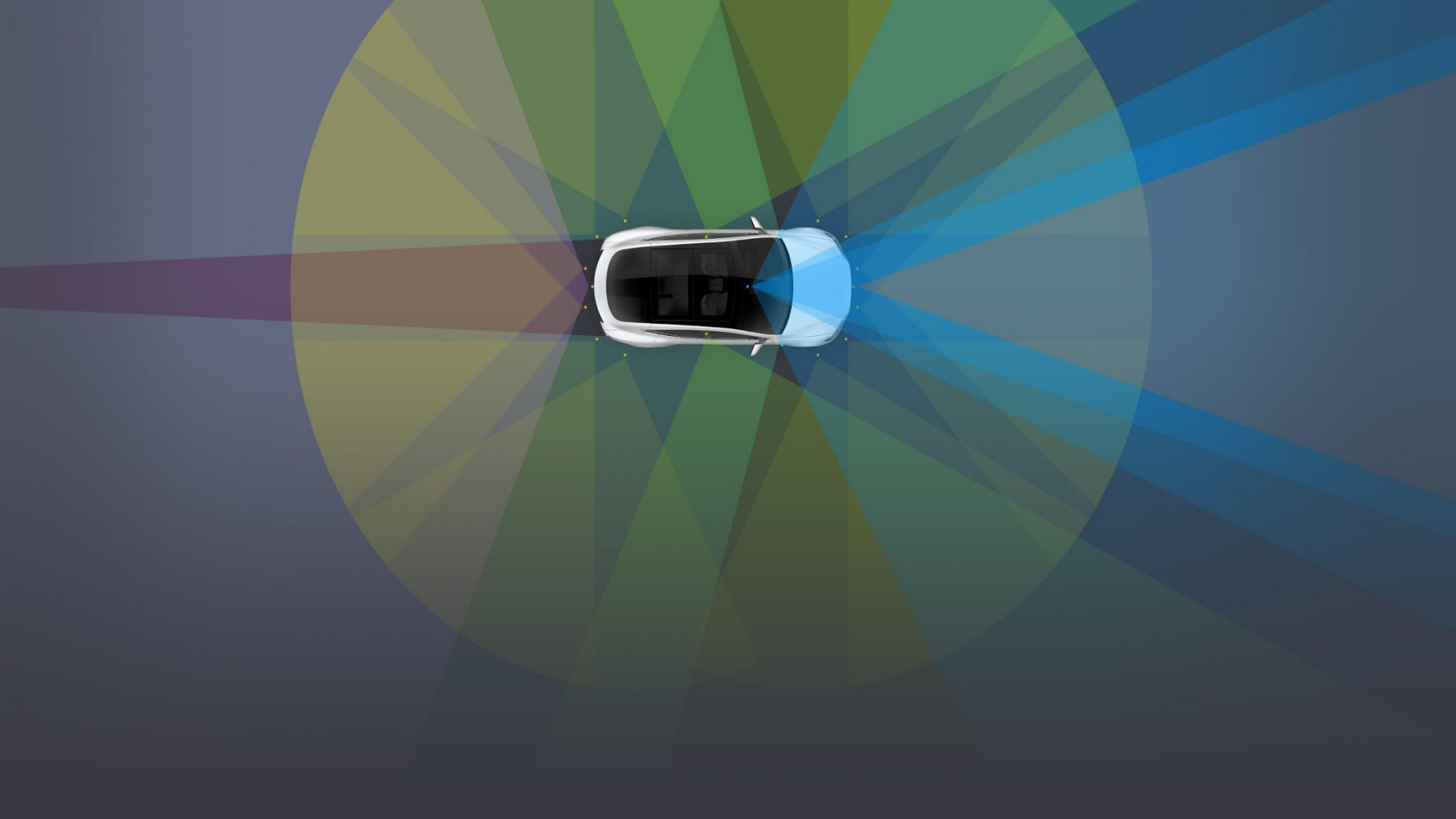
CONS:

- Low memory footprint
- Higher relative training time due to higher relative accuracy

Ranking of said Relevant Features:

- Hour: .368
- OuterLaneWidth: .208
- SafetyEquipment: .117
- RoadCategory: .111
- Localisation: .105
- CollisionType: .092


Telecom
33
20.0
20.0



Ending thoughts for a more credible valuable project:

- 1st Establish/ evaluate baseline model
- ML model monitoring & feedback
- ML model to baseline model evaluation via A/B Testing

Link to the corresponding Jupyter Notebook:

https://github.com/pman117/Data_Science_Portfolio/blob/master/End_to_End_Data_Products/Predict_Death_by_Auto_Accident/Predict_Death_by_Auto_Accidents_.ipynb

Link to the corresponding folder containing entire project:

https://github.com/pman117/Data_Science_Portfolio/tree/master/End_to_End_Data_Products/Predict_Death_by_Auto_Accident