Predicting Stop and Search Outcomes in Scotland

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The Problem

Stop and search

- Resources spent stop and searches that yield no results
- Stop and search can be invasive
- Stop and search is regarded as a controversial power by some
- Well documented links to likelihood of being stopped and searched to race

Deprivation is a significant social problem in Scotland.

Are we able to predict stop and search outcomes based on deprivation and use this to target policy and resources?

The Data - Police Scotland Stop and Search Data

All stop and searches recorded:

- Date & Time
- Location (354 electoral wards)
- Reason for search
- Type of search
- Result (positive/negative)
- What was found (if anything)
- Age, ethnicity, gender of suspect

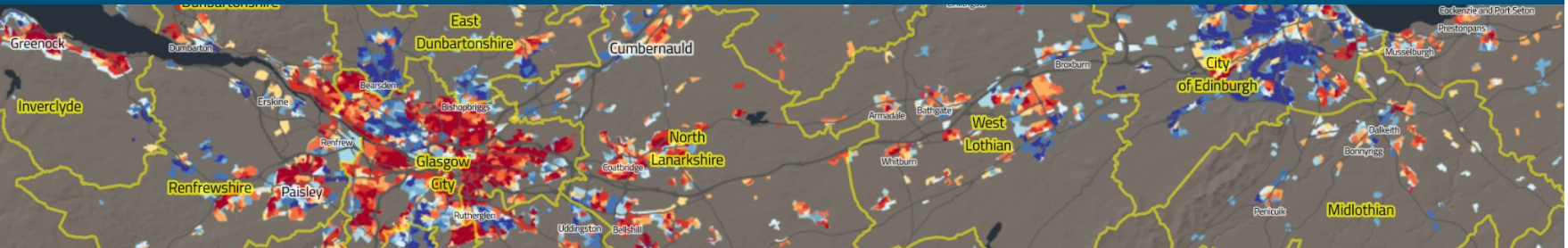
The Data - Scottish Index Multiple Deprivation

Compiled by Scottish Government to quantify deprivation in 6,976 data zones.

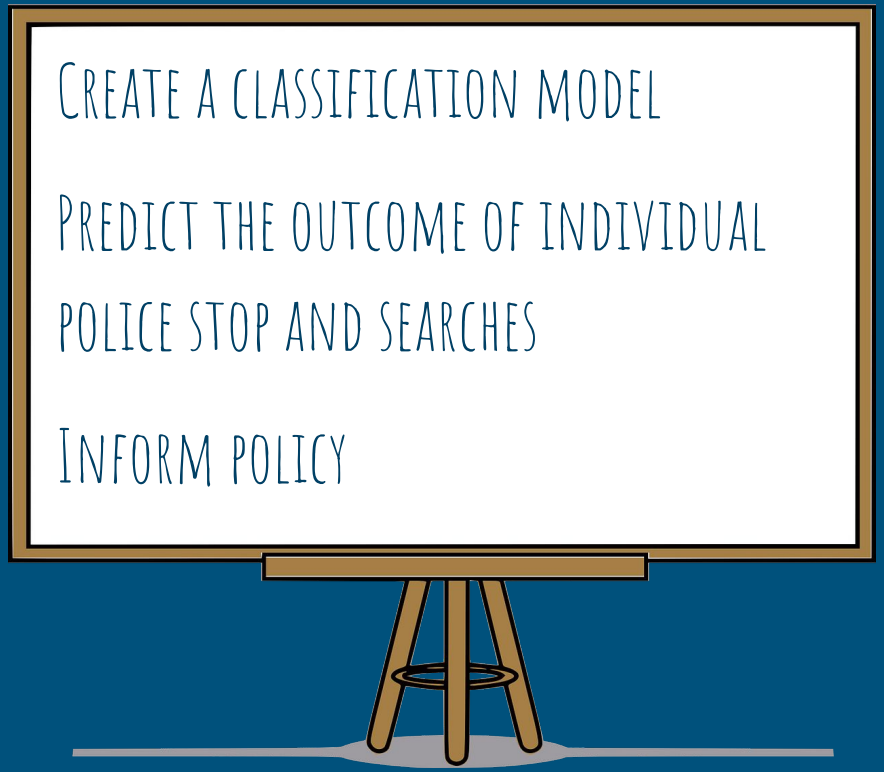
Used by government and researchers to improve understanding about the outcomes of people living in areas of deprivation.

31 features in 7 domains:

1. Income
2. Employment
3. Health
4. Education, Skills and Training
5. Geographic Access to Services
6. Crime
7. Housing



Machine Learning



Consequences of Incorrect Predictions

False Positives

- Police would target stop and search in the wrong way.
- The number of unnecessary stop and searches would increase.
- This could harm the reputation of police in the community with a range of possible consequences.

False Negatives

- Police reduce stop and searches that would yield a positive result.
- Illegal drugs/weapons/alcohol would remain unseized and could cause harm and increase in crime.

We care about both consequences equally.

Measuring Success

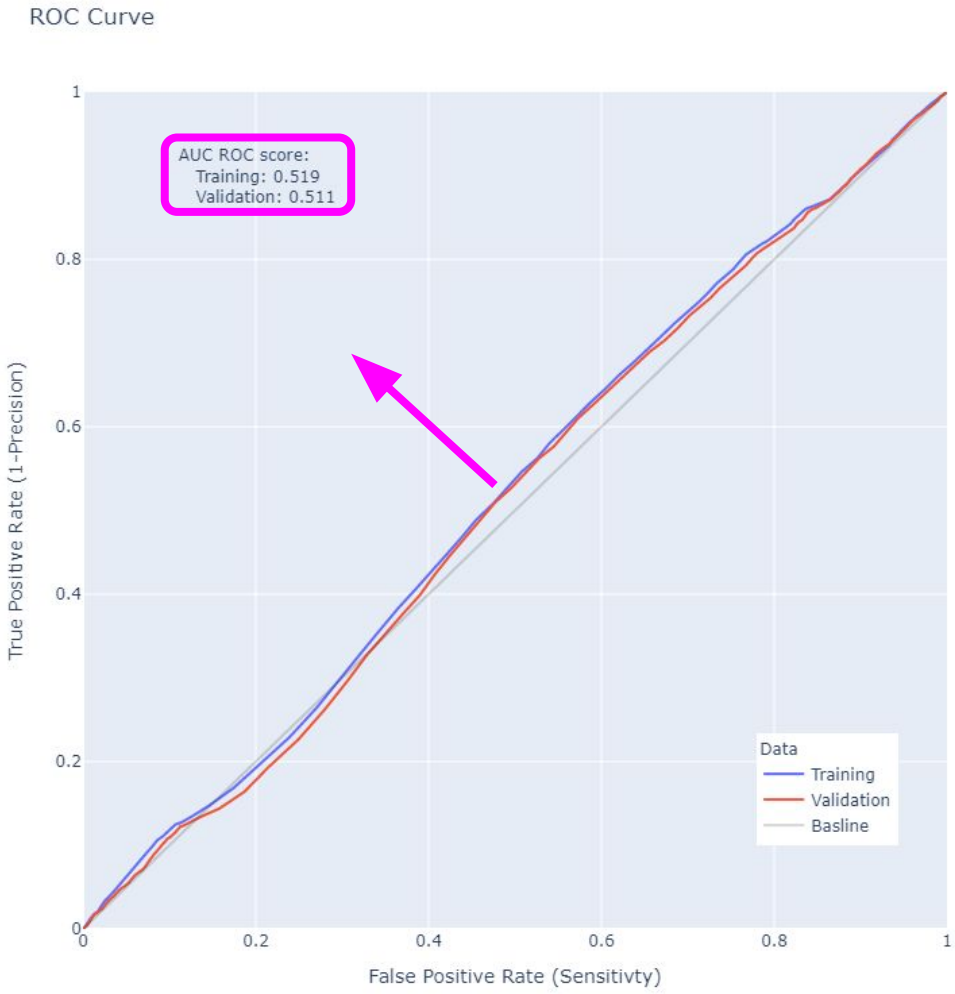
1. High performing model
    a. Low false positive and false negative rates
    b. High precision
2. Interpretation of the model that can inform policy

The Model

Age
Gender
Ethnicity

Very little predictive power

Surprising result!



Add:

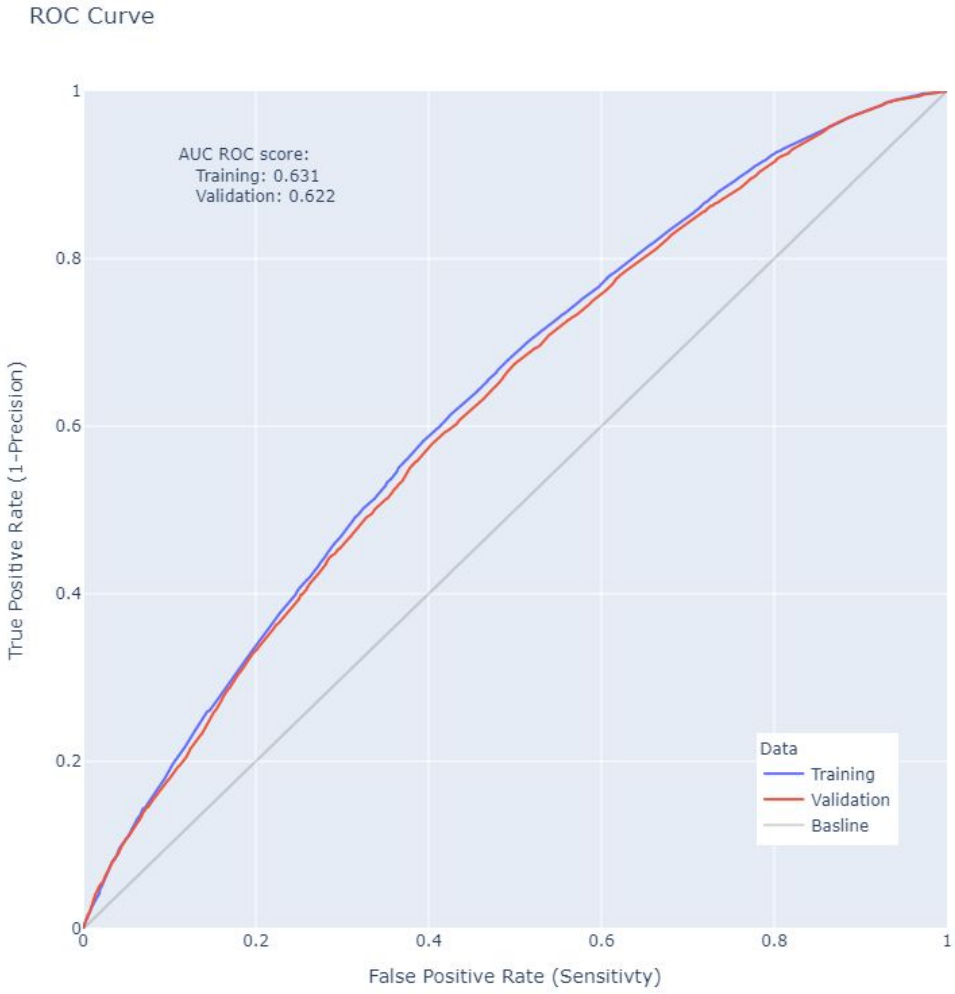
Area Command
Search Reason

Model now has some signal

Still poorly predictive

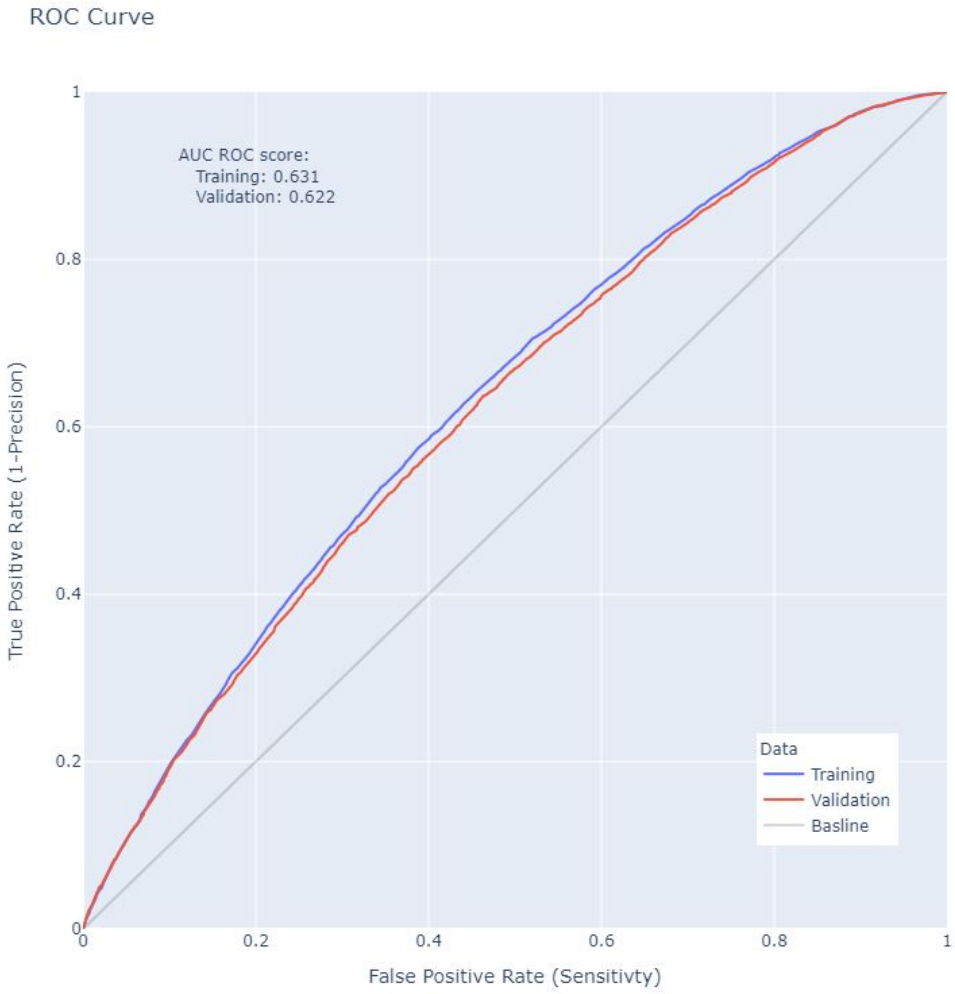
Other stop and search features with no effect:

- Search statute
- Council Area
- Police Division and Command



Add:
SIMD Features

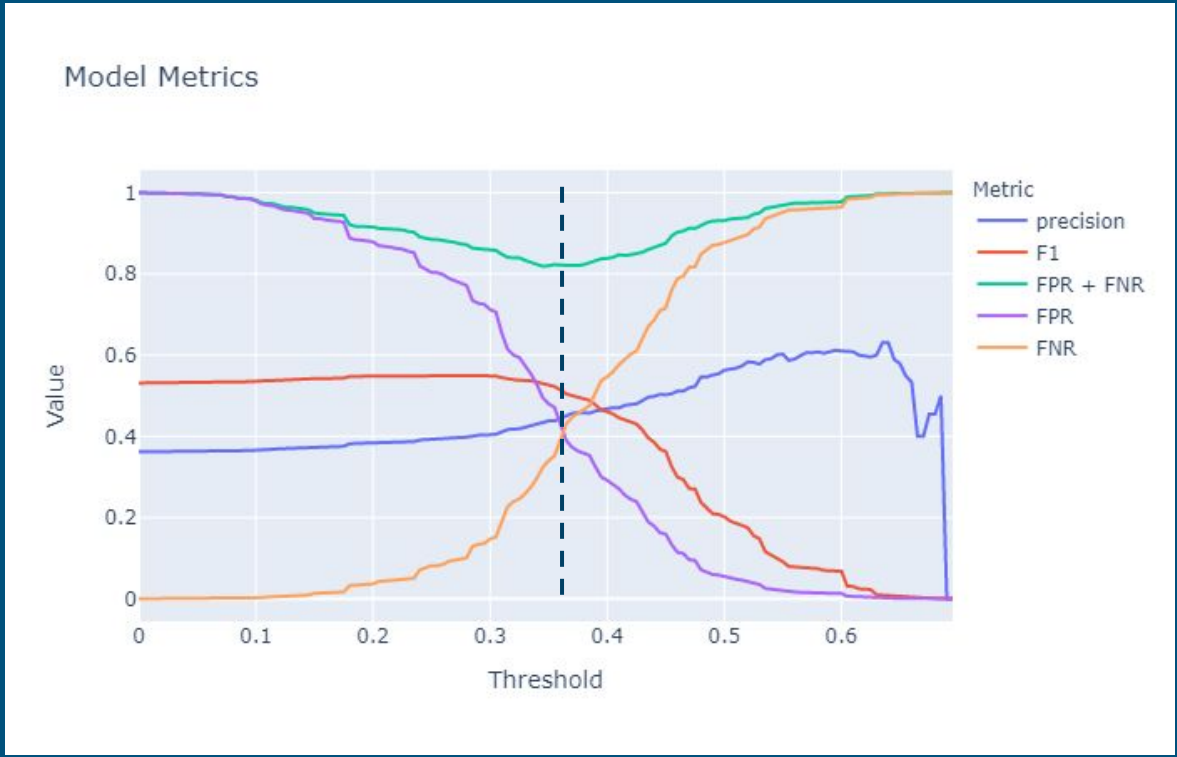
None of the SIMD features have had an impact



Threshold Optimisation

We care about both false positives and false negatives

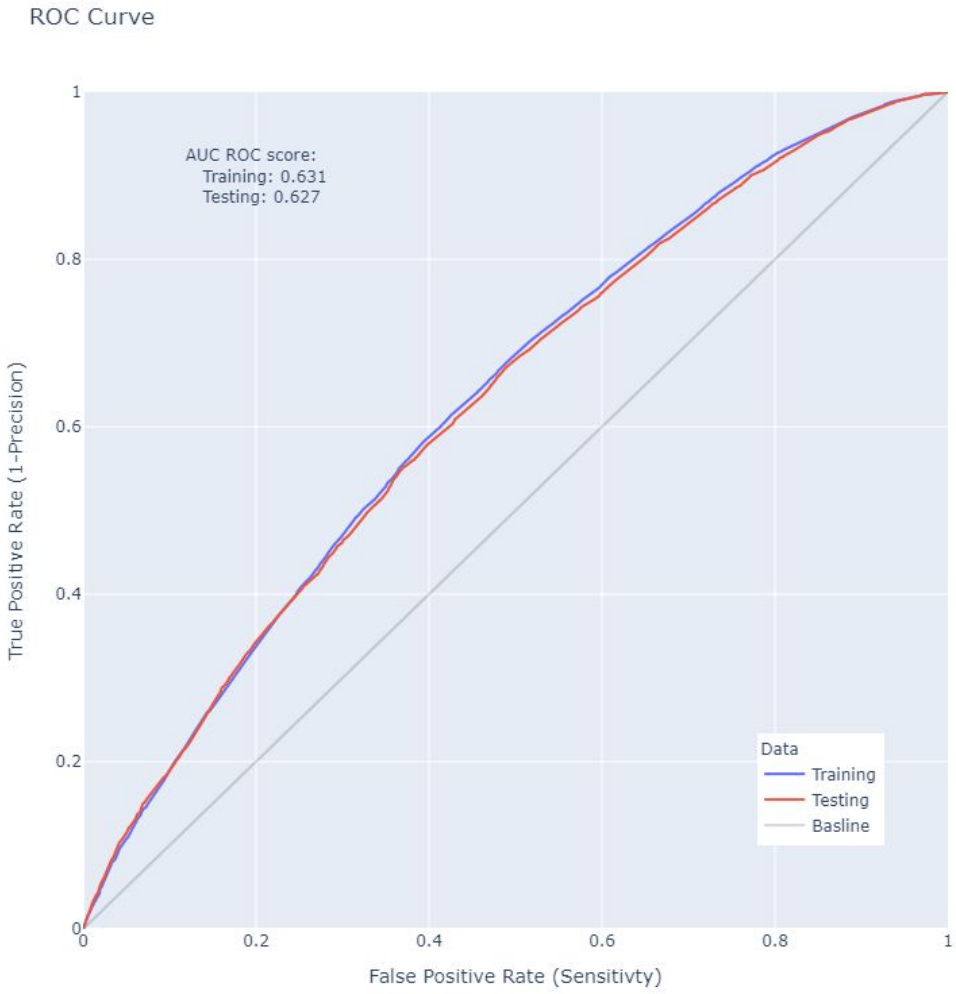
Saddle point of FPR + FNR at **threshold of 0.36**



Test Data

Similar performance to training and validation

Metric	Value
F1	51%
Precision	44%
Negative Predictive Value	72%
False Negative Rate	39%
False Positive Rate	43%



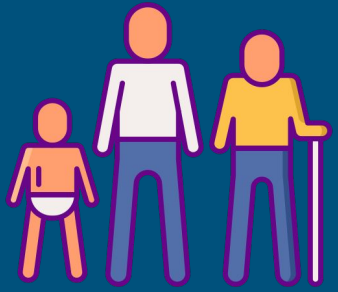
Interpretation

What the Model Doesn’t Say

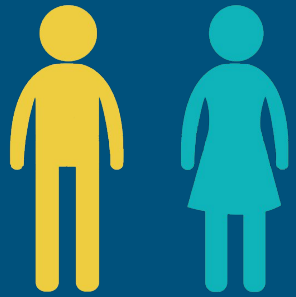
- ➔ Who gets stopped or why they were targeted
- ➔ Number of stop and searches for/in a group/area
- ➔ We are only looking at the outcome once someone is stopped

Almost no predictive value in...

Age



Gender



Ethnicity

Search Reason is the Single Biggest Predictor

1. Warrant
2. Stolen Property
3. Drugs
4. Protection Of Life
5. Firearms/Crossbows
6. Weapons
7. Other
8. Care & Welfare

Area Command

Only other influence

Why?

- Differing policy within a policing our council region
- Prevalence of certain types of crime/activity (although the crime rate did not seem to be a good predictor, we did not have a feature that old us about rate of different types of crime)
- Any other myriad range of factors that vary from area to area that were not captured in any of our available data

Summary

1. High performing model

   Little predictive power within the available data.

   When predicting positive, the model will be wrong 66% of the time.

   When predicting negative, the model will be wrong 28% of the time.

   Given the context the model would be used in, would not recommend using something that does not perform exceptionally well.

2. Interpretation of the model that can inform policy

   Stop and search outcomes are independent of discriminatory factors

   Some regional variation but unclear why