Consumer Data Research Centre

An ESRC Data Investment

WEST MIDLANDS FIRE SERVICE

Predicting Building Fire Severity

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Background and Motivation

While data science methods have frequently been applied to firefighting data, such applications have largely been isolated to the context of wildfires. The potential benefits of predictive modelling for urban fire services remain unstudied. This research project applies data science to the context of urban fire services to help support data driven decision making. Within both academic and industry circles, there has been a growing shift from a 'rapid response' strategy to a more nuanced 'fit for purpose' approach. Existing literature also suggests that energy efficient homes are less likely to experience severe fires owing to the enhanced building standards and fireproof insulation.

Data and Methods

This research focused on incidents between January 1st, 2013, and January 1st, 2023, where at least four fire appliances attended to filter out non-severe fires. The dataset was created from data provided by the WMFS as well as additional property information. Fire severity was predicted using a Monte Carlo cross-validation of 6 different machine learning models, whilst free text was analysed using Natural Language Processing techniques.

Key Findings

Whilst the models were not accurate enough for operational use within WMFS (R^2 of 0.2), they still provided valuable insights. This included high entropy of arrival times, and poorly insulated homes being associated with high fire severity. These findings were consistent across the Monte Carlo cross-validations. Both these findings provide avenues to improve policy in the 'fit for purpose' response strategy. NLP analysis of free text incident logs identified that these communications could be classified into three types: 'after action reports', 'ongoing incident information', and 'casualty information'. In addition, there were indications of a hierarchical typology, suggesting nuanced patterns that may warrant further study.

Value of the research

This research demonstrates the potential applications data science methods have on firefighting data and provides evidence of the benefits that could be had when moving from a data-driven decision-making process to a data optimised one. The findings have immediate policy implications for WMFS, suggesting a revaluation of response protocols and outreach programs, especially for high-risk properties. Moreover, the study lays the groundwork for future research to explore other variables or factors that may influence fire risk and severity.

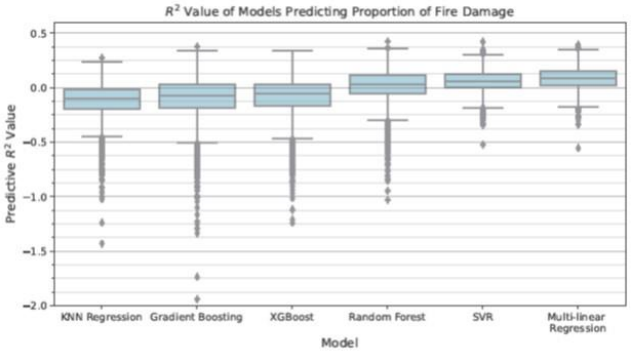

Figure 1: Boxplot identifying the predictive ability of each machine learning model.

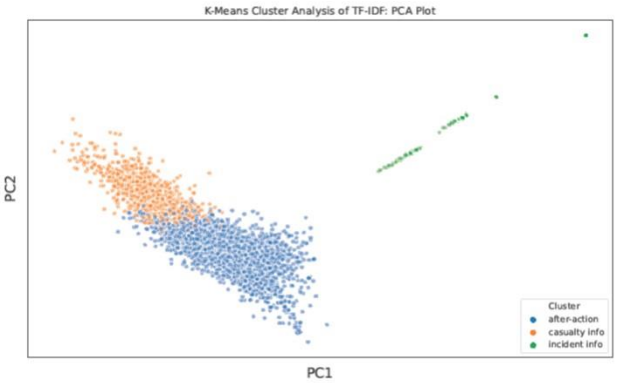

Figure 2: Scatterplot depicting the distinct clustering of incident free text log messages, resulting from the NLP analysis.