

Hazard estimation and capacity planning for the Fire Services

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In a recent paper, we developed a tree-based method to estimate the hazard map for spatial point patterns in the covariate domain. The goal of this project is to extend this approach to multi-type point patterns in space and time and use it for capacity planning.

The application we have in mind is data on fires obtained from the Twente Fire Brigade. They operate from 29 stations scattered over the region. Each station is equipped with a number of fire trucks (the standard pumper as well as several more specialised ones) and a number of professional and volunteer staff. We also have at our disposal the locations and times of labelled incidents from 2004–2020 as well as a great many putative covariates. The fire brigade would like to know how to distribute their resources (in terms of staff and equipment) over the stations based on the estimated hazard map and subject to legal requirements regarding emergency response times.

The goal of this master assignment is two-fold:

- i) study covariate-based intensity estimation for multi-type spatio-temporal point patterns and implement it in the R-package `spatstat`,
- ii) and use the results for capacity planning.

The project requires expertise from data science, statistics and operations research. Further recent fire data can be collected and used to validate the utility of the proposed method.

Reference:

C Lu, Y Guan, M N M van Lieshout and G Xu. XGBoostPP: Tree-based estimation of point process intensity functions. Arxiv 2401.17966, January 2024.