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The Mathematics of Fires

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Abstract Fires continue to be a leading cause of property loss, psychological effects, physical damage and death in modern society. In literature, several approaches are used to predict and model fire occurrences. Regardless the approach, most studies emphasize the need to consider spatial techniques to model fire occurrences as they offer the possibility to consider spatial autocorrelation, either in the response variable, the explanatory variables and/or the random error terms.

Forest fires incidence has been increasing sharply in recent years having reached, in Portugal, a burned area of 0.8% of the country area in 2020 (www.pordata.pt).

Large fires change instantaneously vast areas having substantial societal and environmental impacts frequently becoming major disasters. Since extreme values of fire size occur necessarily in the upper tail of a probability distribution, the mean and variance alone may not be sufficient to fully characterize those events. Hence, in this case, the extreme value theory (e.g. generalized extreme value (GEV) with a Poisson point process) may be an important tool to deal with historical extreme fire data.

Finally, fire stations (FS) provide a global emergency response to non-fire incidents, e.g., vehicle crashes. In Portugal, FS are very non-uniformly

spatially distributed between municipalities both in terms of number and geographical location. Since the spatial configuration of fire stations may considerably influence the effectiveness of the provided services, national and regional governments need research-based advice on how many and where to establish firefighting facilities. The problem of optimizing the location of FS is still to answer in Portugal.

In this talk these research questions will be presented and discussed.

Keywords: Fires, Statistical modelling, Spatial statistics.

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