PROBABILITY OF FIRE IGNITION AND ESCALATION

bushfire&natural HAZARDS CRC

John Hearne[1], Nicholas Read[2], Peter Taylor[2]

[1] School of Mathematical and Geospatial Sciences, RMIT University, Victoria

[2] Department of Mathematics and Statistics, University of Melbourne, Victoria

The literature on probabilities of fire ignition is large for two reasons: there are numerous different models which are in turn applied to dozens of different locations. This poster will serve to summarise four of the key modelling approaches used. Themes of interpretability and demands on the data are quick to emerge. A model with high interpretability will not only allow for prediction and simulation, but will give some characterisation of the causes driving the physical process. Since data is rarely in the desired form, the more particular the demands on the data, the more work required to massage it into the correct form.

LOGISTIC REGRESSION is the most common model in the ignition literature, probably due to its simplicity and interpretability. The model cuts the landscape up into a grid and gives the probability of fire on a grid cell using the inputs for that grid cell. Typical inputs are the Fire Weather Indices, Burning Index, lightning density, distance to nearest settlement, precipitation, relative humidity, wind speed, temperature, vegetation and topographic variables.

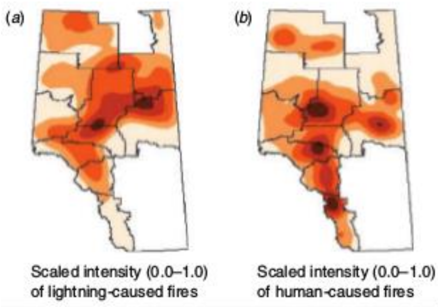
- *Quick and easy to implement with existing software packages*
- *Good interpretability which reflects the fire science*
- *Demands data on a grid, which usually creates extra work*
- *The model is linear in the covariates, which can be a crude approximation*
- *Poor ability to deal with long term changes in the fire process*
- *Poor ability to deal with the clustering of fires*

NEURAL NETWORKS, also known as machine learning techniques, are the ultimate black box model using nothing but the data to perform inference. There strength lies in their ability to detect high dimensional patterns in data that humans are unable to notice otherwise.

- *No restrictions on the form of the data*
- *Some find they have better predictive ability than linear regression models*
- *Very limited interpretability*
- *Uninformed by the science*

POINT PROCESSES are a diverse class of models that provide a very flexible framework for modelling the arrival of fire. They can be constructed in a way that reflects the science offering a high level of interpretability.

- *Excellent interpretability*
- *Places little demand on the form of the data*
- *Flexible output*
- *Can allow long term shifts in the climate and environment*
- *Can incorporate more complex interactions between fires*
- *Gets very analytically and numerically complicated*



A plot of the fitted intensity function of a fire process which changes over the years of 1980 to 2007. Taken from Wang, Y, Anderson, K.R, 2010. An evaluation of spatial and temporal patterns of lightning- and human-caused forest fires in Alberta, Canada, 1980-2007. International Journal of Wildland Fire, 19, 1059 – 1072.

EXTREME VALUE THEORY attempts to understand the extremes of a process which is difficult to do with other techniques due to the lack of data.

- *Allows us to study the extremes of the fire process, something that other techniques are extremely poor at*
- *Restricted to the extreme events. Must be part of a suite of models if we are to understand the whole fire process*
- *Not very interpretable*

A common approach is to cut the data on fire sizes into blocks, such as years or decades, and to consider the maximum value in each block.