Risk Assessment: a Forest Fire Example

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Abstract

The concern of this paper is obtaining baseline values for the number of forest fires as a function of time and location and other explanatories. A model is developed and applied to a large data set from Federal lands in the state of Oregon. To proceed the data are grouped into small spatial-temporal cells (voxels). Fires are rare so there are many of these voxels with no fires. In fact there are so many such cells that in the analyses presented a sample is taken to make the work manageable. The paper sets down a likelihood for the sampled data and fits a generalized additive model involving location, elevation and day of the year as explanatories.

Keywords: Forest fires; generalized additive model; Oregon; risk analysis; sampled data; wildfires

1 Introduction

Forest fires represent a problem of considerable societal importance. We mention the following report that appeared in the San Francisco Chronicle of 7/16/2002,

> ... *Nearly two weeks ago, the Forest Service used up the entire $321 million budgeted for firefighting in 2002. It is expected to spend another $645 million by the end of the year.* ...*Wildfires have already burned more than 3.3 million acres this year, more than twice the yearly average over the last decade.*

The concern here is the development of a risk model for use in estimating the probability of a forest fire taking place at a particular location and time as a function of those and other explanatory variables. The work is implemented for the case of a fine grid of cells and an accompanying large data set. An analysis is carried out for a region surrounding the state of Oregon, henceforth referred to as Oregon, and employing: location, elevation and day of year as explanatories. The elements of the approach are:

1. a spatial-temporal point process and associated covariates,
2. likelihood-based inferential methods developed for such processes,
3. approximation of the point process by a 0-1 valued process on a lattice,
4. a sampling of the 0; *i.e.* no-fire cells,
5. generalized additive model technology.