Joint modelling and data analysis of wildfire hazards

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Wildfire has been increasingly studied due to, in particular, its destructive power in many regions in recent years. Statistical models of wildland fires in general aim to understand, characterize and predict fire behavior from different fire responses such as duration, burned area (size), frequency, cost, and damage. Although these responses can be analyzed separately, we believe that a joint analysis for some of them may be more appropriate since they are potentially correlated. For instance, fire size is related to fire duration, especially as the former is a time-dependent variable. In this work, we develop a joint modelling of wildfire hazards based on both various responses and topological, meteorological, economical and environmental risk factors. The correlation among fire outcomes is captured through a jointly distributed latent variable that may be related to the centroid of the fire centre. We also focus on predicting wildfire outcomes in order to respond rapidly to wildfires that threaten communities and reduce the interval between initial attack and final control times. These proposed hazard models are very flexible joint models that allows a very broad range of dependencies among outcomes. They may also include fixed effects, random effects, and measurement error into the expected outcomes, as well as involving Weibull parametric and Cox semi-parametric approaches. We compare the results of our joint models to those obtained from readily available alternatives, e.g., separate hazard models under classical and Bayesian perspectives.

Keywords: multiple outcomes; mixed-effects model; duration analysis; wildfires.