Smooth-CAR Mixed Models for Spatial Count Data

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We propose the use of Penalized splines ([1]) and individual random effects for the analysis of spatial count data . In a first model, the spatial variation is modelled by a two-dimensional, no-isotropic, smooth Penalized spline ([2]) where the centroids of the areas or regions are considered as spatial locations in terms of their geographical longitude and latitude. The basis for regresion and the penalties are based on the Kronecker products of basis and penalties in each dimension. Penalized splines are represented as mixed models to give a unified approach to the model estimation procedure. Then, the counts in each region are assumed have been observed in the centroid of the region. A similar approach would be to consider the interpolation of regional data as continuous surfaces, as it happens in geostatistical methods such as *kriging* or Gaussian Random Fields. Additionally, individual area-effects are incorporated as random effects to account for individual variation between regions, and the Negative Bionomial distribution was also considered as an alternative. In a second model, we combine a smooth model and random effects with a CAR structure given by the neighbouring areas. We called these models: *"Smooth-CAR"* models. The aim is to be able to separate the large-scale spatial trend and the small-space regional variation, and estimate both effects simultaneously. We applied the proposed models to the analysis of lip cancer incidence cases in Scotland over the period 1975-1980. The analysis of data showed a better performance of Smooth-CAR models in terms of AIC and BIC criteria over other spatial models.

References

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