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Title: Improved inference for areal unit count data using graph-based optimisation

Abstract:
Count data relating to a set of non-overlapping areal units are prevalent in many fields, including epidemiology and social science. The spatial correlation inherent in these data is typically modelled by a set of random effects that are assigned a conditional autoregressive (CAR) prior, which is a special case of a Gaussian Markov random field model. The spatial correlation structure implied by this model depends on a binary neighbourhood matrix, where two random effects are assumed to be partially autocorrelated if their areal units share a common border, and are conditionally independent otherwise. This paper proposes a novel graph-based optimisation algorithm for estimating the neighbourhood matrix from the data, by viewing the areal units as the vertices of a graph and the neighbour relations as the set of edges. The superiority of our methodology compared to the commonly used border sharing rule is comprehensively evidenced by simulation, before the method is applied to a new respiratory disease surveillance study in the Greater Glasgow and Clyde Health board in Scotland between 2011 and 2017.

Warning - this talk contains absolutely no details on graph theory!