The Use of Convex Hulls and Control Charting for Monitoring Disease Events

A. Sachlas[1]; S. Bersimis[1]; P. Economou[2]

1   Department of Statistics & Insurance Science, University of Piraeus
2   Department of Civil Engineering, University of Patras

Abstract:
Both spatial and temporal dimensions should be considered to early detect infectious disease outbreaks, since not only global changes in the number of new disease events on time is of interest but also any possible hotspots of disease events. Although a key assumption in biosurveillance is that under normal conditions disease events are uniformly distributed in the plane, in many cases there is heterogeneity under the null hypothesis because population is spatially varying. This problem is strongly related to the size of the area under investigation. Usually as the size of the area under investigation increases, the population variation increases also causing the violation of the assumption of uniform distribution under the null hypothesis. In this work, we propose a monitoring procedure to simultaneously monitor the number of disease events through control charting and the spatial distribution of disease events through convex hulls choosing appropriately the size of the area under investigation in order to preserve population uniformity under the null hypothesis. The numerical illustration showed an excellent performance of the proposed procedure under different outbreaks scenarios.

Keywords:
Biosurveillance; Convex Hulls; Disease outbreaks; Control Charting

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