

FleXScan: A Flexible Scan Statistic for Detecting Clusters

Toshiro Tango and Kunihiko Takahashi

Department of Technology Assessment and Biostatistics,
National Institute of Public Health,
Wako, Saitama, Japan

The circular spatial scan statistic proposed by Kulldorff (1997) has been applied to a wide variety of epidemiological studies for cluster detection. This scan statistic, however, uses a circular window to define the potential cluster areas and thus has difficulty in correctly detecting actual noncircular clusters. A recent proposal by Duczmal and Assuncao (2004) for detecting noncircular clusters is shown to detect a cluster of very irregular shape that is much larger than the true cluster in our experiences.

We propose a flexible spatial scan statistic that can detect irregular shaped clusters within relatively small neighborhoods of each region. The performance of the proposed spatial scan statistic is compared to that of Kulldorff's circular spatial scan statistic with Monte Carlo simulation by considering several circular and noncircular hot-spot cluster models. For comparison, we also propose a new bivariate power distribution classified by the number of regions detected as the most likely cluster and the number of hot-spot regions included in the most likely cluster.

The circular spatial scan statistics shows a high level of accuracy in detecting circular clusters exactly. The proposed spatial scan statistic is shown to have good usual powers plus the ability to detect the noncircular hot-spot clusters more accurately than the circular one.

The proposed spatial scan statistic is shown to work well for small to moderate cluster size, say 30. For larger cluster sizes, however, the method is not practically feasible and a more efficient algorithm is needed.