

Abstract

Surveillance methods are needed for detecting a change in a sequence of random variables, quickly and accurately. The application determines which models that are appropriate, and what properties of surveillance methods that are especially important.

A spatial system is a statistical model for phenomena occurring in space. In a spatial system, the distribution of observations made at places in a geographical region depends on the distance between these places according to a spatial model. Spatial surveillance has the aim to detect a change in the distributions of random variables of a spatial system. Results on univariate surveillance can sometimes be used in spatial surveillance.

This thesis contains results on univariate and spatial surveillance. It is based on three papers.

In Paper I, performance measures of surveillance methods for univariate monitoring are given for the case when the shift in the mean of the process differs from that for which the methods are optimised.

Paper II considers sequential observations of a spatial system. The spatial model is an auto-logistic model (known as the Ising model), and the focus is on surveillance of the interaction parameter in it. A univariate minimal sufficient statistic is derived. This statistic has simple asymptotic properties and univariate surveillance may be conducted. Some general methods of surveillance can be used. This is illustrated by examples. The results from Paper I are applicable to the results of this study.

In Paper III, the focus is on detection of environmental catastrophes. A harmful increase of the level, of some substance, that spreads with e.g. the wind, is considered. For the situation of no spread, it is possible to use previous studies on univariate and multivariate surveillance. Different kinds of spreading scenarios are discussed and treated. Methods for detecting the shift taking the spread into account, are suggested. A brief evaluation of these methods is made. An application to radiation data for detecting an increase in radiation, is considered. The method used today is compared to some alternative ones.

Key words: Surveillance, Specified shift size, True shift size, False alarm, Expected delay, Predictive value, Tree disease detection, Ising model, Change in interaction, Spatial process, Multivariate normal distribution, Simply ordered shift process, Radiation data.

AMS 2000 Subject Classification: 60K35, 62H11, 62L15, 93E10.