

On Spatial Dependence in Multivariate Singular Spectrum Analysis

Richard Awichi

Abstract

In this paper, I present a method for utilizing the usually intrinsic spatial information in spatial data sets to improve the quality of temporal predictions within the framework of singular spectrum analysis (SSA) techniques. The SSA-based techniques constitute a model free approach to time series analysis and ordinarily, SSA can be applied to any time series with a notable structure. Indeed, it has a wide area of application including social sciences, medical sciences, finance, environmental sciences, mathematics, dynamical systems and economics. SSA has two broad aims: i) To make a decomposition of the original series into a sum of a small number of independent and interpretable components such as a slowly varying trend, oscillatory components and a structure-less noise. ii) To reconstruct the decomposed series for further analysis in the absence of the noise component. Multivariate singular spectrum analysis (MSSA) is an extension of SSA to multivariate statistics and takes advantage of the delay procedure to obtain a similar formulation as SSA though with larger matrices for multivariate data. In situations where spatial data is an important focus of investigation, it is not uncommon to have attributes whose values change with space and time and an accurate prediction is thus important. The usual question asked is whether the intrinsic location parameters in spatial data can improve data analysis of such data sets. The proposed method is based on the inverse distance technique and is exemplified on climate data from Upper Austria for the period Jan 1994 to Dec 2009. Results show that the proposed technique of incorporating spatial dependence into MSSA analysis leads to improved quality of statistical inference.

Keywords: Time Series Analysis, MSSA, Inverse Distance Weighting, Spatial Dependence