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Marginal Maximum Likelihood Estimation of SAR Models with Missing Data

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Abstract

Maximum likelihood (ML) estimation of simultaneous autocorrelation models is well known. Under the presence of missing data, estimation is not straightforward, due to the implied dependence of all units. The EM algorithm is the standard approach to accomplish ML estimation in this case. An alternative approach is considered, the method of maximising the marginal likelihood. At first glance the method is computationally complex due to inversion of large matrices that are of the same size as the complete data, but these can be avoided, leading to an algorithm that is usually much faster than the EM algorithm and without typical EM convergence issues. Another approximate method is also proposed that serves as an alternative, for example when the contiguity matrix is dense. The methods are illustrated using a well known data set on house prices with 25,357 units.

Keywords: SAR model, EM algorithm, marginal likelihood, missing data, maximum likelihood

1. Introduction

Simultaneous autoregressive models (SAR) are popular linear regression models for spatially distributed data that take the dependence of the response variable of neighbouring units into account. Maximum likelihood (ML) estimation for SAR models is well established (Ord, 1975). The dependence of neighbouring units is represented by the contiguity matrix \mathbf{W} ,

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