GAUSSIAN LINEAR DYNAMIC SPATIO-TEMPORAL MODELS AND TIME ASYMPTOTICS

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Abstract

Gaussian linear dynamic spatio-temporal models (LDSTMs) are linear gaussian state-space models for spatio-temporal data which contains deterministic or (and) stochastic spatio-temporal covariates besides the spatio-temporal response. They are extensively used to model discrete-time spatial time series data. The model fitting is carried out either by classical maximum likelihood approach or by calculating Bayesian maximum a posteriori estimate of the unknown parameters. While their finite sample behaviour is well studied, literature on their asymptotic properties is relatively scarce. Classical theory on asymptotic properties of maximum likelihood estimator for linear state-space models is not applicable as it hinges on the assumption of asymptotic stationarity of covariate processes, which is seldom satisfied by discrete-time spatial time series data. In this article, we consider a very general Gaussian LDSTM that can accommodate arbitrary spatio-temporal covariate processeses which grow like power functions wrt. time in deterministic or (and) suitable stochastic sense. We show that under very minimal assumptions, any approximate MLE and Bayesian approximate MAPE of some of the unknown parameters and parametric functions are strongly consistent. Furthermore, building upon the strong consistency theorems we also establish rate of convergence results for both approximate MLE and approximate MAPE.

Keywords: Approximate MLE, Gaussian LDSTM, linear state space model, spatio-temporal covariates, spatial time series data.

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