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NONPARAMETRIC SPECICATION OF ERROR TERMS IN DYNAMIC MODELS [1]

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In this paper the first order polynomial dynamic model is considered introducing a nonparametric specification of the error terms, using mixtures of Dirichlet processes. In order to make inference about the relevant parameters of the model the Gibbs Sampling approach is used. The approach is suitable to cope with features like outliers and changes in level, both for prediction and detection purposes, showing some characteristics of robustness due to the memory of the processes. An example is shown using artificial data.

1. Introduction. From their original formulation, the state space models for nonstationary time series have been widely used and largely improved.

In the Bayesian approach, advances trying to remove the normality assumption for the error terms can be recognized in West et al. (1985) and, more recently, Carlin et al. (1992) introduced the Gibbs sampling approach to the estimation of a multivariate nonnormal, nonlinear state space model, covering a wide variety of possible distributions. Besides these attempts and in order to robustify the estimation of the state parameters, Meinhold and Singpurwalla (1989) specified the distributions of the error terms and the state parameters as (multivariate) Student-t, being able to cope with outlying observations. In order to avoid strict assumptions on the error terms, a possible solution can be found in the nonparametric approach; in the Bayesian framework, Ferguson (1973) introduced the Dirichlet process (DP), later leading also to a solution for the nonparametric density estimation problem via Mixtures of Dirichlet processes (MDP) (Antoniak, 1974; Ferguson, 1983). Since substantial computational difficulties arise also for rather small amount of data, a Gibbs sampling solution was proposed by Escobar (1988) and Escobar and West (1995).

In this paper we merge the two approaches, producing a simple univariate first-order polynomial model with error terms specified in a nonparametric way.

As an important special case of nonnormal error terms, we focus our attention on modelling discrepant observations. We will show how the uncertainty about the distribution of the error terms allows to sensibly process such observations; these can represent different features of the data, which must be differently treated in the estimation of the state and of the other parameters of the model.

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