Dynamic Linear Models in R

Giovanni Petris
University of Arkansas, USA

Dynamic Linear Models (DLMs) are a very flexible tool for time series analysis. In this talk we introduce an R package for the analysis of DLMs. The design goal was to give the user maximum flexibility in the specification of the model. The package allows to create standard DLMs, such as seasonal components, stochastic polynomial trends, regression models, autoregressive moving average processes and more, and it also provides functions to combine in different ways elementary DLMs models as building blocks of more complex univariate or multivariate models. For added flexibility, completely general constant or time-varying DLMs can be defined as well.

The drawback of allowing so general models to be used is that for many DLMs the standard algorithms for Kalman filtering and smoothing are not numerically stable. The issue has been addressed in the package by using filtering and smoothing algorithms that are based on the recursive calculation of the relevant variance matrices in terms of their singular value decomposition (SVD). The same SVD-based algorithm employed for Kalman filter is also used to find maximum likelihood estimates of unknown model parameters.

In addition to filtering, smoothing and maximum likelihood estimation, the package provides some functionality for simulation-based Bayesian analysis of DLMs. A function that generates the unobservable states from their posterior distribution is available, as well as a multivariate version of adaptive rejection Metropolis sampling, which can be used to generate random vectors having an essentially arbitrary continuous distribution. Both generators can be fruitfully employed within a Gibbs sampler or other Markov chain Monte Carlo algorithm.

In the talk I will give an overview of the most important features of the package, illustrating them with practical examples.