# Estimating Spectral Density Functions Robustly

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## Abstract

The spectral density function is a commonly used tool when analyzing time series in the frequency domain. Areas of applications are signal processing (cf. Thomson, 1994), geophysics (cf. Chave et al., 1987) and medicine (cf. Hartikainen et al., 1998). Classical spectral density estimation is done either nonparametric using Fast Fourier Transformation (FFT) or parametric via an approximation of the signal by autoregressive moving average (ARMA) models.

Unfortunately, classical spectral density estimators are not robust in the presence of additive outliers (cf. Martin and Thomson, 1982). Hence, we consider in the following the problem of robust spectral density estimation.

In order to get a robust estimate of the spectral density function, it turned out that cleaning the time series in a robust way first and calculating the spectral density function afterwards leads to encouraging results. To meet these needs of cleaning the data we use a robust version of the Kalman filter which was proposed by Ruckdeschel (2001). Similar ideas have already been proposed by Martin and Thomson (1982).

All methods are implemented in R (cf. R Development Core Team, 2005) and compared by extensive simulation experiments. The most competitive methods are also applied to real data. As a special practical application we focus on actual heart rate variability measurements of diabetes patients.

## Bibliography

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