Robust and Consistent Estimation of Fixed Parameters in General State-Space Models

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State-Space Framework

State-space models (SSMs) encompass a wide range of popular models encountered in various fields such as mathematical finance, control engineering and ecology. SSMs are essentially characterized by a hierarchical structure, with latent (unobserved) variables governed by Markovian dynamics. Fixed parameters in these models are traditionally estimated by maximum likelihood and typically include regression, auto-regression and scale parameters. The sensitivity of these estimates to deviations from the assumed model is problematic, all the more so since distributional assumptions about latent variables cannot be verified by the data analyst.

Robust Estimates of Fixed Parameters

Standard robust estimation techniques from generalized linear and time series models cannot be directly adapted to SSMs, and this mainly because of high-dimensional integrals that generally need to be approximated. We propose a robust estimating method inspired by the unpublished work of **?**, where we downweight observations on the joint log-likelihood scale and then approximate the marginal robustified log-likelihood by Laplace's method. Computing a Fisher consistency correction term involves further approximations at the joint likelihood level to recover a typical M-functional form. Encouraging simulation results are presented with an application to a fish stock assessment.

References

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