Robust Bayesian Auto-regression Model

[1] Jan Šindelář

The problem of estimating parameters of an auto-regression model in a Bayesian paradigm has been solved before, when the model has innovations coming from exponential family [3]. The main reason for choosing exponential family was the simplicity of computation and the fact that Gaussian distribution, often found in nature due to existence of limit theorems, is also a member of this family.

Applications of modeling to data, where the distribution of innovations is known to be heavy-tailed calls for a method, more robust with respect to possible outliers. Such methods have been developed in the past [1],[2] often using a likelihood with Huber loss function in the exponent or similar approximations. With the use of such methods a constant specifying the position of the tails has to be chosen, which is often difficult.

Intead, we choose the 1-D innovations of the model to be Laplace distributed, choose a Bayesian conjugate prior to such a model distribution and try to compute the resulting filtration, when new data of a realization of an adjacent random process arrive.

The computation of the resultant posterior distribution of the parameters of the model is still computationally tractable as will be shown [4]. The computation is slower than the classical solution at a ratio $1 : N^k$, where N is the number of data used for computation and k is the dimension of the parameter space. An immediate guess would be to use a moving window estimation of the parameters, making the estimation faster and the model adaptive. An efficient algorithm has been proposed to solve the presented problem [5].

References

[1] P. J. Rousseeuw, A. M. Leroy *Robust Regression and Outlier Detection* Wiley, 2003.

[2] P. J. Huber *Robust Statistics.* Wiley, 1981.

[3] M. Kárný, J. Böhm, T. V. Guy, L. Jirsa, I. Nagy, P. Nedoma, L. Tesař *Optimized Bayesian Dynamic Advising, Theory and Algorithms* Springer, 2005.

[4] J. Šindelář Bayesian vector auto-regression model with Laplace errors applied to financial market data *Conference on Mathematical Methods in Economics, MME2010.*

[5] J. Šindelář Algorithm for splitting and merging complexes of convex polyhedra according to given hyperplanes in general dimension *11th International PhD Workshop on Systems and Control a Young Generation Viewpoint 2010.*

[1]Department of Adaptive Systems, Institute of Information Theory and Automation ASCR, *jan.sindelar@utia.cas.cz*