An information-geometric method for parameter estimation on autoregressive models

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We propose an iterative method for parameter estimation and model selection for autoregressive models on the context of time series. Our method is an application of the bisector regression algorithm [1] and maintains its efficiency and variable selecting nature.

We apply our algorithm to autoregressive models whose model manifold F is a dually flat space. In a dually flat space there exist two useful coordinate systems an m-affine coordinate system and an e-affine coordinate system. We define the subspace S in F that corresponds to autoregressive models of order p.

In our algorithm the starting point of the estimator is the maximum likelihood estimation point contained in S. The estimator moves along the curve defined by the bisector, or its analogy to higher dimensions, of m-geodesics between the current estimation point and its projections on certain specific subspaces of S, that are defined by the algorithm. This bisector curve analogy is defined as the point whose divergence to the m-geodesics mentioned before is the same for every m-geodesic. At each iteration, the estimator's movement along the bisector analogy stops when it hits one of the mentioned subspaces of S, and we define the stopping point as the new estimate. The new estimate has a new zero valued component on its e-flat coordinates.

In our method the autocovariance and inverse autocovariance values of the estimated models are used as parameters. In our algorithm the number of iterations it takes, the number of estimates it outputs and the number of explanatory variables of the desired model are all equal making it an efficient algorithm. This algorithm performs parameter selection by reducing one parameter on the output estimated model at the end of each iteration.

We run numerical experiments with the obtained algorithm and compare its efficiency on variable selection with the graphical lasso algorithm [2], a sparse and shrinkage estimator that through penalized-likelihood methods performs model selection and estimation. We run the numerical experiments on different orders of autoregressive models and different sizes of data samples.

References

[1] Y. Hirose and F. Komaki (2010). An extension of least angle regression based on information theory of dually flat spaces. *Journal of Computational and Graphical Statistics*, **19**(4), 1007–1023.

[2] M. Yuan and Y. Lin (2007). Model selection and estimation in the Gaussian graphical model. *Biometrika*, **94**(1), 19–35.