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*A Penalized Quasi-Likelihood Approach for Estimating the Number of States in a Hidden Markov Model*

In applications of hidden Markov models (HMMs), one may have no knowledge of the number of states (or order) of the model needed to represent the underlying process of the data. We present a penalized quasi-likelihood method for order estimation in HMMs which utilizes the fact that the marginal distribution of the HMM observations is a finite mixture. The method starts with a HMM with a large number of states and obtains a model of lower order by clustering and merging states through two penalty functions. Its performance is assessed theoretically, via simulation, and with the help of a real data application.