Some hidden Markov models with additional dependence

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Hidden Markov models can be used to provide a modelling framework for many environmental processes. They can be modified in several ways to accommodate more dependence among observations and this can provide a rich class of flexible models that are useful in many environmental applications. We consider hidden Markov models that incorporate additional dependence among observations in two different ways (Ramesh and Onof, 2014). One approach is to introduce additional dependence between the state level and the observation level of the process and the other is to incorporate dependence at observation level of the process.

Formulation of the additional dependence models and the construction of their likelihood functions, for both approaches, are described. Some special cases of the models and the associated second-order properties of the process are studied. We employ the maximum likelihood methods to estimate the parameters of the models. Proposed models are used to analyse winter season daily rainfall data from England. Results of the analysis show that the models incorporating additional dependence between the state level and observation level of the process capture the structure of the rainfall distribution well whereas the class of models that incorporate dependence at observation level reproduced the autocorrelation structure of the process better than the other models considered.

Reference:
Ramesh, N.I, Onof, C. (2014). A class of hidden Markov models for regional average rainfall. *Hydrological Sciences Journal*. Vol.59 (9), 1704 -1717.
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