G37 – Research Fellows Meeting

Presenter's Abstract

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Let's talk Semi-Markov models in discrete-time, how they are defined, why they are non-trivial, why they are important and an example on how to build a HsMM (Hidden semi-Markov model)

Finite-state stochastic processes have many applications in the real world. For example, suppose we Consider how a mobile phone user might use a small set of say 5 popular applications. What might be the sojourn times our user spends on each app? How are these sojourns distributed? What might be the state/app transition probabilities from one app to another? Communication companies might be interested in such modelling for all sorts of reasons.

However, should we just proceed straight to the garden variety off-the-shelf null hypothesis for a partially observed finite state model, that is, a Hidden Markov Model (HMM)? If we do so, we must recall that the EM algorithm is an algorithm for parametric statistical models and is thereby closed under the class it considers. This means we get the best fitting HMM, this means geometric sojourns for every state, this means every (estimated) state sojourn is memoryless. Should that hold in the mobile phone example? Most likely not.

Semi-Markov models address precisely this problem, how to build a finite-state stochastic model with arbitrary sojourn distributions. In this seminar we detail exactly what the prefix "semi" means in "semi-Markov". We show how to construct a semi-Markov model based upon an embedded Markov renewal chain and how to simulate such models. The greater task for us however is how to build estimators for partially observed semi-Markov models.

In this seminar we do so for a 3-state example and in so doing build an "exact" estimator. This is important as it provides a benchmark to which suboptimal estimators might be compared.

Exact estimators are also useful to determine important properties like stability etc.