

**University of California, Irvine
Statistics Seminar**

Extending Multivariate Hidden Markov Models

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Hidden Markov models are a popular class of time series models where the observation process depends on a latent state process taken to evolve over time according to a Markov chain. However, when modeling multivariate observation processes, oftentimes researchers use an assumption of contemporaneous conditional independence to construct a joint distribution at each time t as a product of marginal distributions. We propose a copula-based extension of the hidden Markov model (HMM) which applies when the observations recorded at each time in the sample are multivariate. The joint model produced by the copula extension allows decoding of the hidden states based on information from multiple observations. However, unlike the case of independent marginals, the copula dependence structure embedded into the likelihood poses additional computational challenges. We tackle the latter using a theoretically-justified variation of the EM algorithm developed within the framework of inference functions for margins. We illustrate the method using numerical experiments and an analysis of room occupancy.