279

Direct (conditional) and net (marginal) effects of environmental predictors in multivariate normal and autologistic models for multispecies modeling

Understanding the effect of the environment on species' abundance and habitat selection is one of the fundamental questions in community ecology besides interspecies interactions. Among the vast literature on multivariate multispecies models, the multivariate normal and autologistic models are the two most widely used. During the formulation of these models, distinguishment is usually made on interspecies interactions about whether the interaction is direct (conditional) or net (marginal), i.e. conditioning on other species and environment or not. For instance, when the direct interaction among species is of interest, researchers use the precision matrix rather than the covariance matrix in the multivariate normal distribution. However, similar distinguishment over conditional and marginal effects is usually not made on species' reaction to the environment. An environment's effect on one species can also be both direct (conditional) and net (marginal) when in multispecies models. The distinguishment is more important when sparsity of interactions (between environment and species as well as interspecies interactions) is to be imposed as conditional sparsity and marginal sparsity are usually not compatible. In autologistics models, some authors propose to use a centering term to account for a "large scale" effect of the environment which approximates a marginal effect. When the conditional effect is of interest, formulating the model without a centering term will give parameters clear interpretations in terms of conditional distributions, but keeping the usual 1-0 coding for presence-absence can be problematic as in the model has the same penalty on co-absence (0x0=0) and only one exists (0x1=0). We propose to use a symmetric +1/-1 coding without a centering term when the conditional effect is of interest. Under normal settings, the regression coefficients with usual mean-precision parameterization should be interpreted as marginal effect of environment (i.e. marginal over all other species). If a conditional effect of environment is of interest, one should use an alternative model to multivariate normal regression namely normal chain graph model (or equivalently a conditional autoregression). We present a Bayesian graphical selection method for the chain graph model to learn sparse networks among species and environments.