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Research statement

I am driven by the challenge, discovery, and contribution of developing new statistical methods for biology, ecology, brain imaging, and public health. By forming multi/interdisciplinary teams, I leverage the great potential for developing new statistical tools. Current interests include Bayesian models for stable isotope sourcing and a variety of other stable isotope collaborations, as well as models for fMRI of the brain.

Stable isotope mixing models

My dissertation work on stable isotope mixing models [1] has opened an untapped area of tremendous potential for research in statistical methods. These models are used in the analysis of animal diets (that is, "how much of an animal's diet comes from each of the sources it consumes?") and other problems where sources contribute to a mixture, such as plant nutrient use, geochemistry, pollution, and forensics. Parameter estimation has been a challenge because there are often many sources and few isotopes leading to an underconstrained linear system for the diet probability vector. We have thus far provided a general frequentist model [2] based on constrained weighted least squares with optional covariates (such as time); an algorithm for an approximate Bayes solution with no variability, implemented in the R software package `sisus` and also provided via a web interface [3, 4]; and a set of flexible Bayesian models [5], including subject-specific consumer diet estimation, prior information, and measurement error, and these models are easily extended to more specific questions. Some specific questions I am currently investigating include estimating an animal's trophic level in the food chain [6], modeling relationships among sources [7], estimating when animals have changed their diet [8], estimating migratory patterns with spatial statistics [9], and finding strategies for each of these models to be easy to implement for the practicing scientist. I have active collaborations with Profs. Wolf and Hanson in UNM Biology in this area, as well as plant and animal ecologists in Europe and New Zealand [10, 11, 12, 13, 14]. Some of these projects could contribute to MS or PhD theses in statistics.

fMRI brain imaging

In brain imaging, I work on models that use fMRI 4D time-volume data to understand which areas of the brain are functionally connected, that is, those areas that are active together over time. I develop both estimation methods [15] and simulation methods for validating estimation techniques [16] (development of a Matlab toolbox [17]), and study and propose strategies for more accurate estimation [18, 19]. My connection with the Mind Research Network on the UNM campus may lead to continued collaboration, and could contribute to MS or PhD theses in statistics.

Public health

I am the statistician for the largest individual case-control study of Hodgkin's disease in children centered at the UNM Cancer Research and Treatment Center. There are a number of publications planned from this work, and others are already completed [20], however, this is not an active area of investigation.

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