

The Institute of Environmental Medicine at the Helmholtz Center Munich is offering a B.Sc./M.Sc. thesis project on the topic:

Diversity measures for microbiome data

We are studying the interaction of humans and their environment in the context of health and disease, with a strong focus on the human microbiome and its bioinformatic and statistical analysis.

Project background: Changes in the human microbiome have been associated with a range of disorders, such as obesity, autism and atopic dermatitis. Compared to healthy subjects, many of these diseases are characterized by an imbalanced microbiome. This imbalance is measured by alpha diversity, which summarizes the complex structure of a microbial community into a single index. A variety of alpha diversity indices exist to measure different aspects of a community, such as the number of unique species occurring in a sample or the dominance of specific species. Despite their frequent use, a review of alpha diversity indices for microbiome data and a thorough comparison of their application in real microbiome samples are lacking.

Objective: We would like to review the appropriateness of traditional and new alpha diversity measures for microbiome data from a statistical point of view, and to compare these diversity measures on mock and clinical microbiome data.

The M.Sc. thesis should cover the following aspects:

- A theoretical/methodological analysis of alpha diversity measures regarding their appropriateness for microbiome data,
- An application-oriented analysis of alpha diversity measures for real mock or clinical microbiome data,
- Additional aspects could be: an analysis on simulated data, an analysis of the indices' components of Richness and Evenness, the effect of unobserved species and sequencing depth, the effect of different taxonomic levels at which diversity analyses are performed, and appropriate corresponding data normalization methods.

A desirable outcome would be a recommendation which measure(s) to use to detect differences in community structures for microbiome data.

We are looking for a motivated student with a strong interest in comparing methodologies and practical biological applications of statistical questions. Experience with (or strong interest in learning) a programming language is required. We are providing an open and supportive working atmosphere with scientists of diverse backgrounds.

If you are interested, please contact luise.rauer@tum.de.