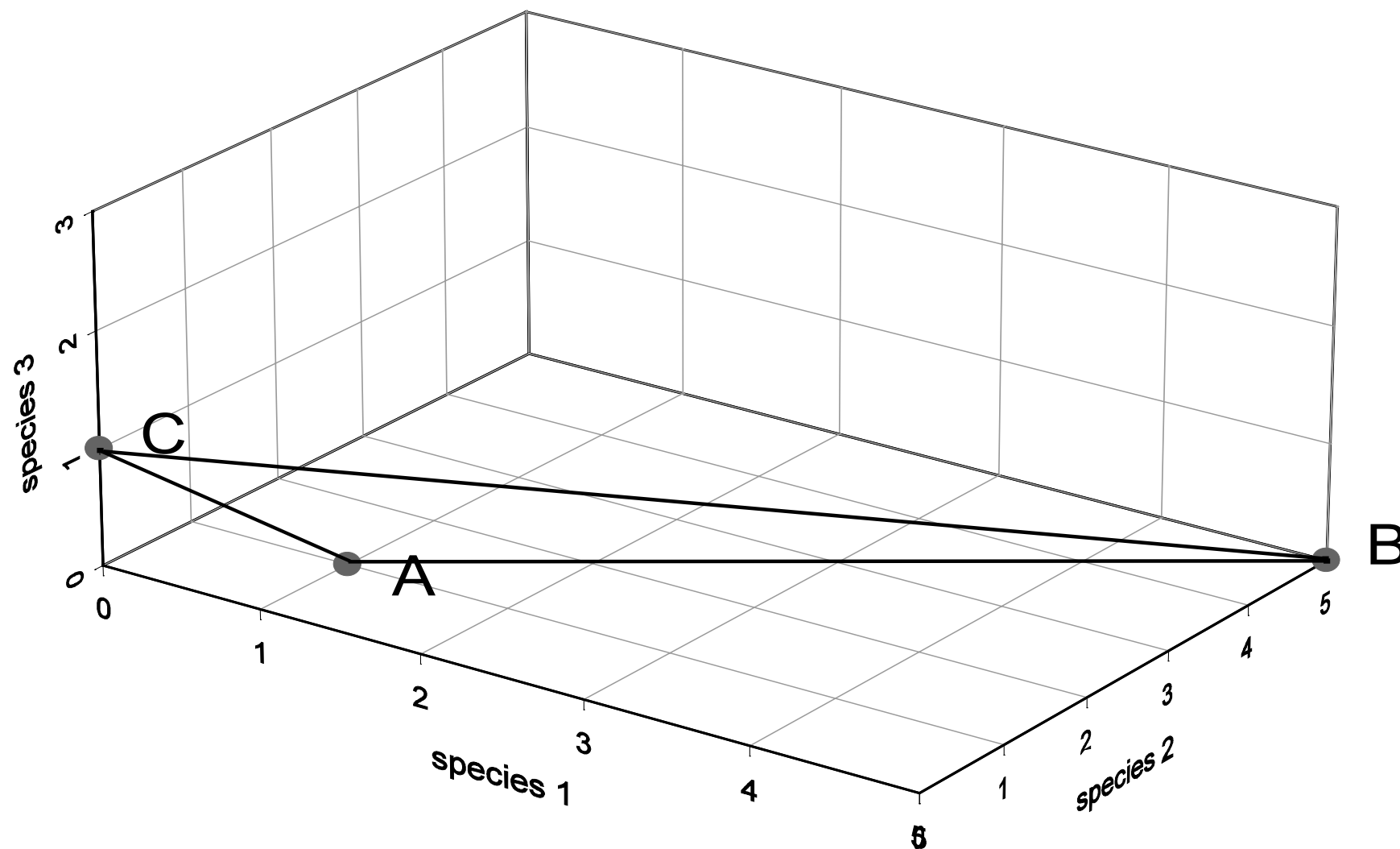


β -Diversity: Ordination and Comparisons

Beta Diversity: How different are sites?

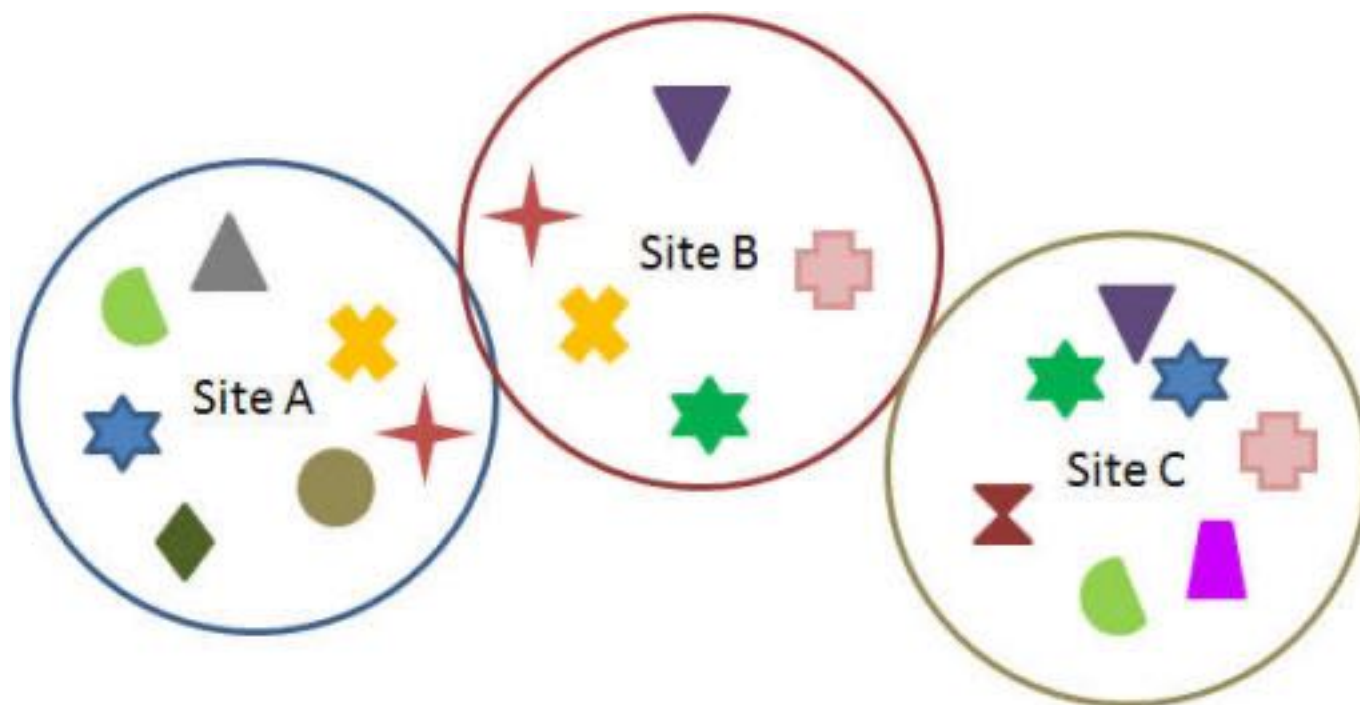


Beta Diversity Metrics

- Number of Taxa
- Bray-Curtis Dissimilarity
- UniFrac
- etc

Number of Taxa

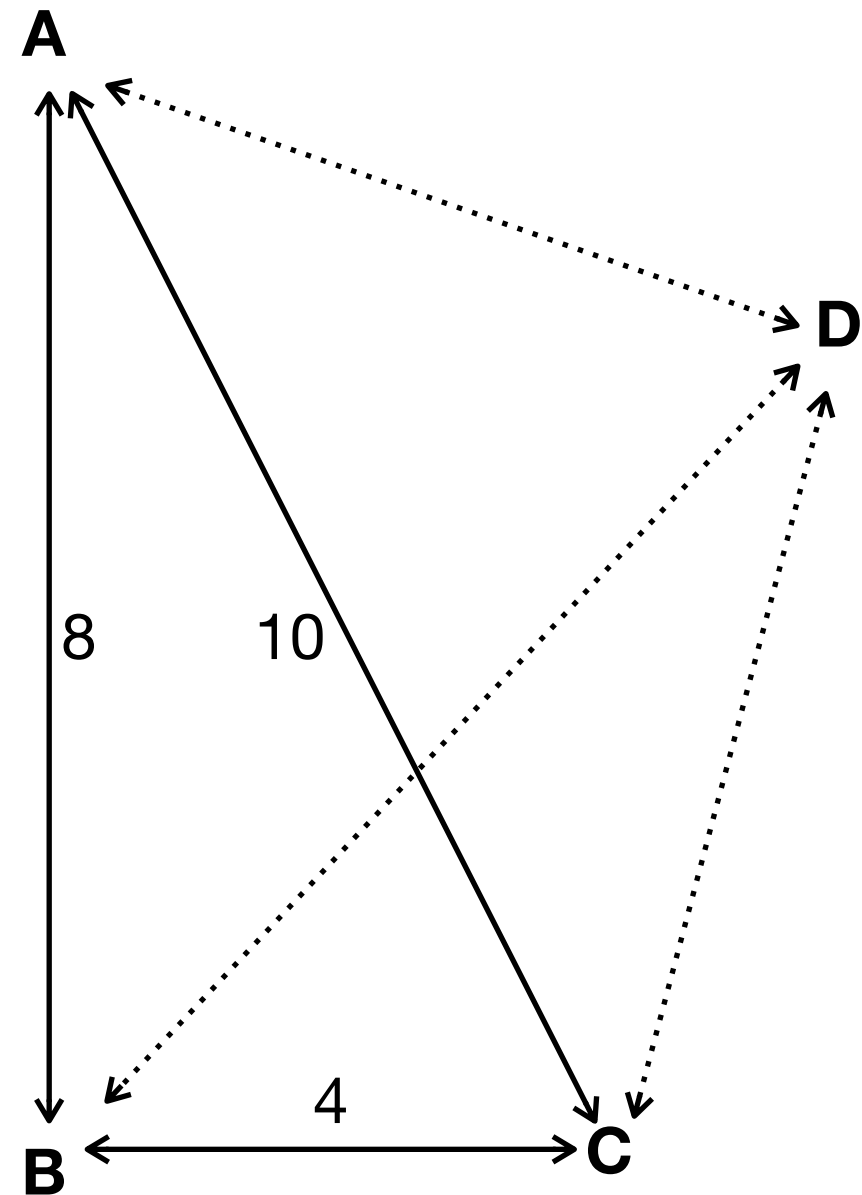
- How different are samples?



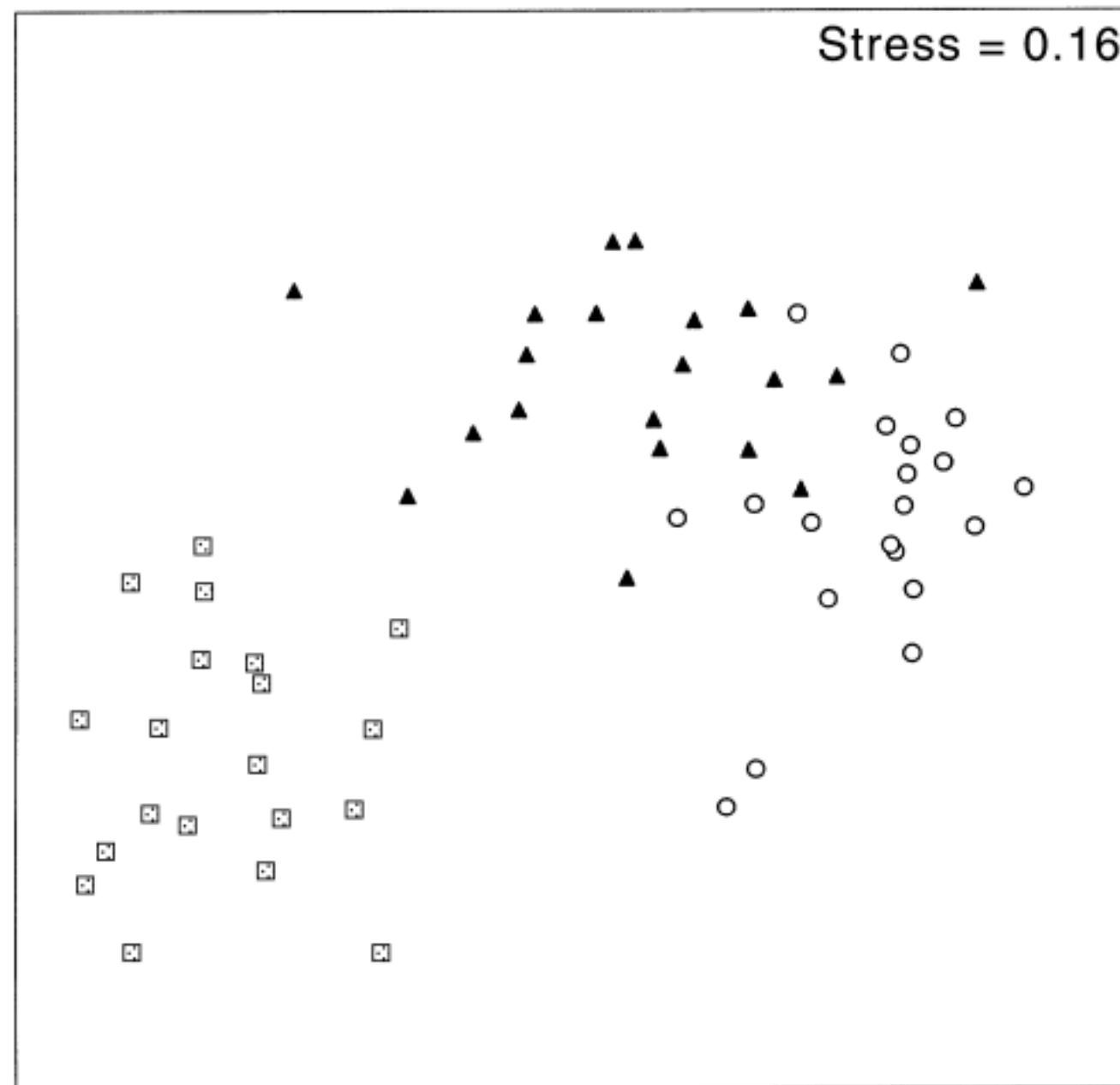
	Species Differences
A vs B	8
B vs C	4
A vs C	10

Dimensionality reduction

	Species Differences
A vs B	8
B vs C	4
A vs C	10



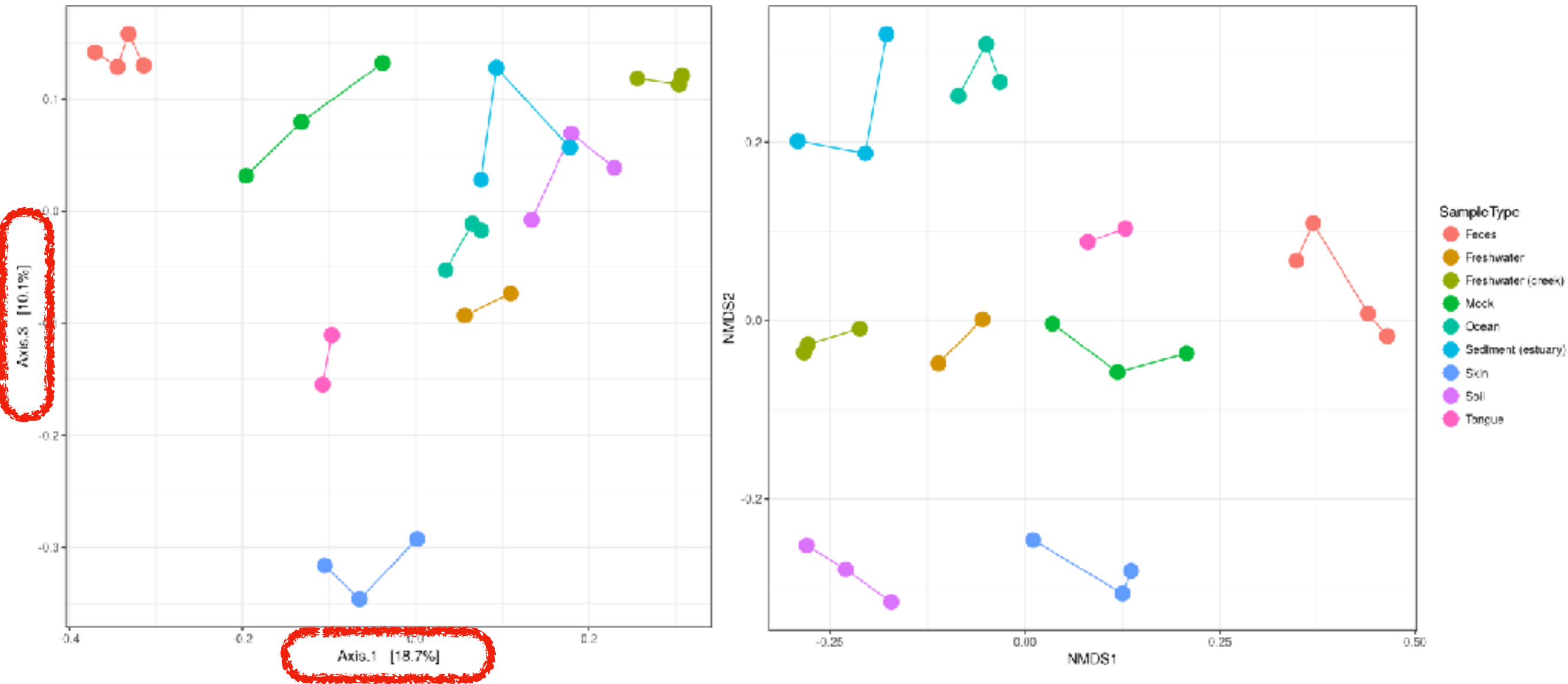
Dimensionality reduction



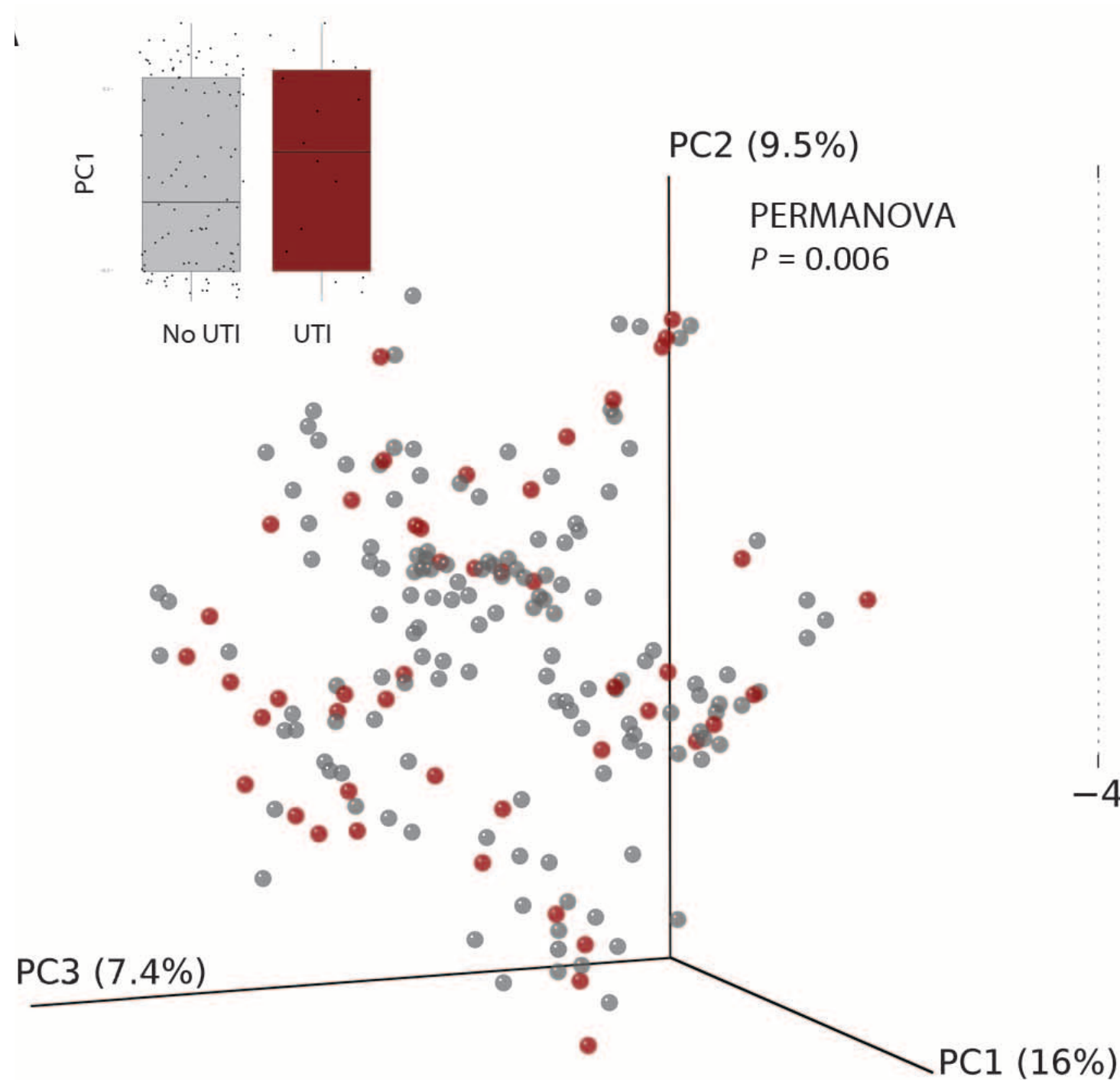
Dimensionality reduction

- **NMDS (Nonmetric Multidimensional Scaling):** attempts to maintain pairwise dissimilarity
- **PCoA (Principal coordinates analysis):** Determines axes along which variance is maximized

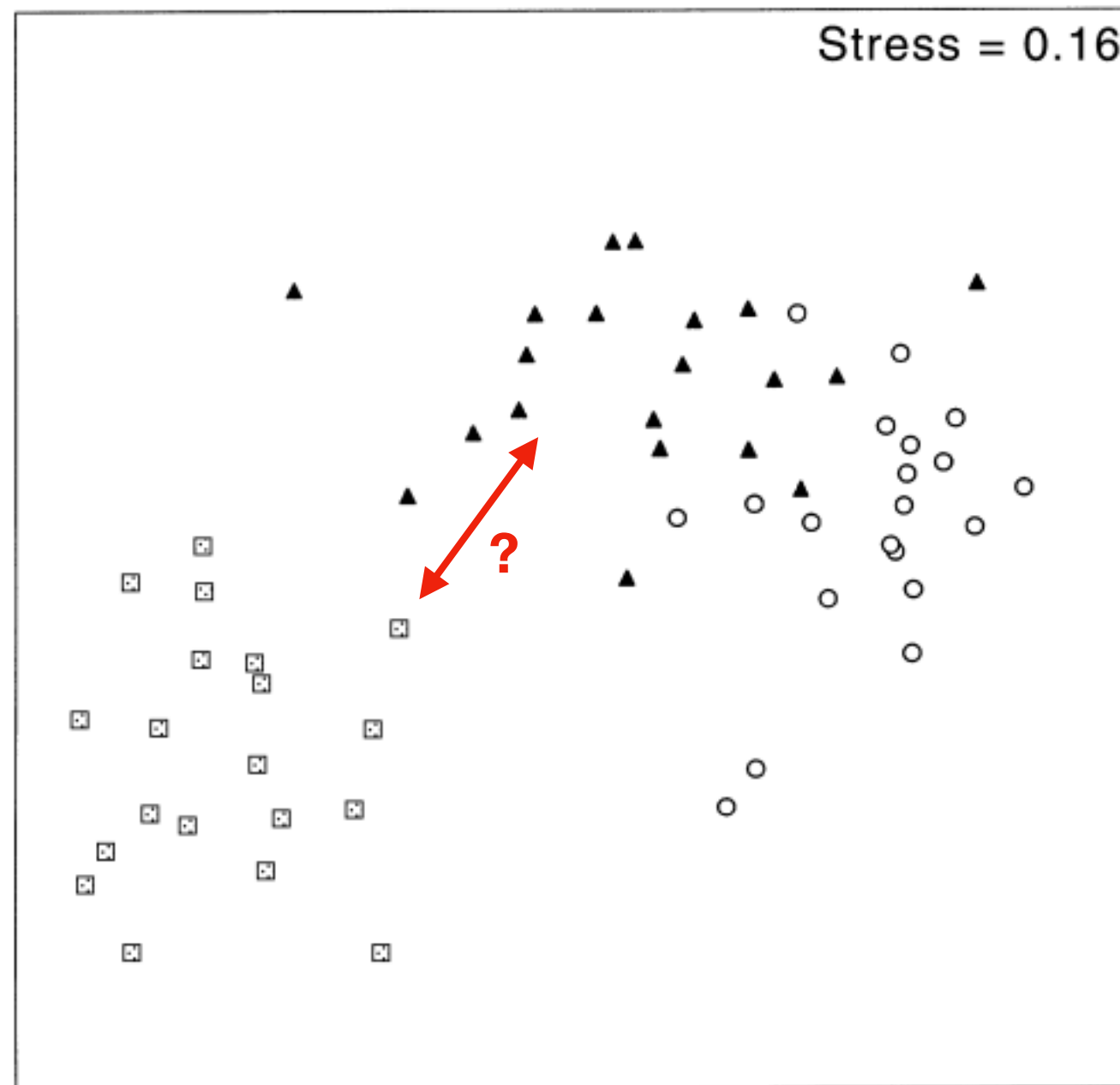
PCoA and NMDS



Figures Josh Hates: 3D PCoA Plots

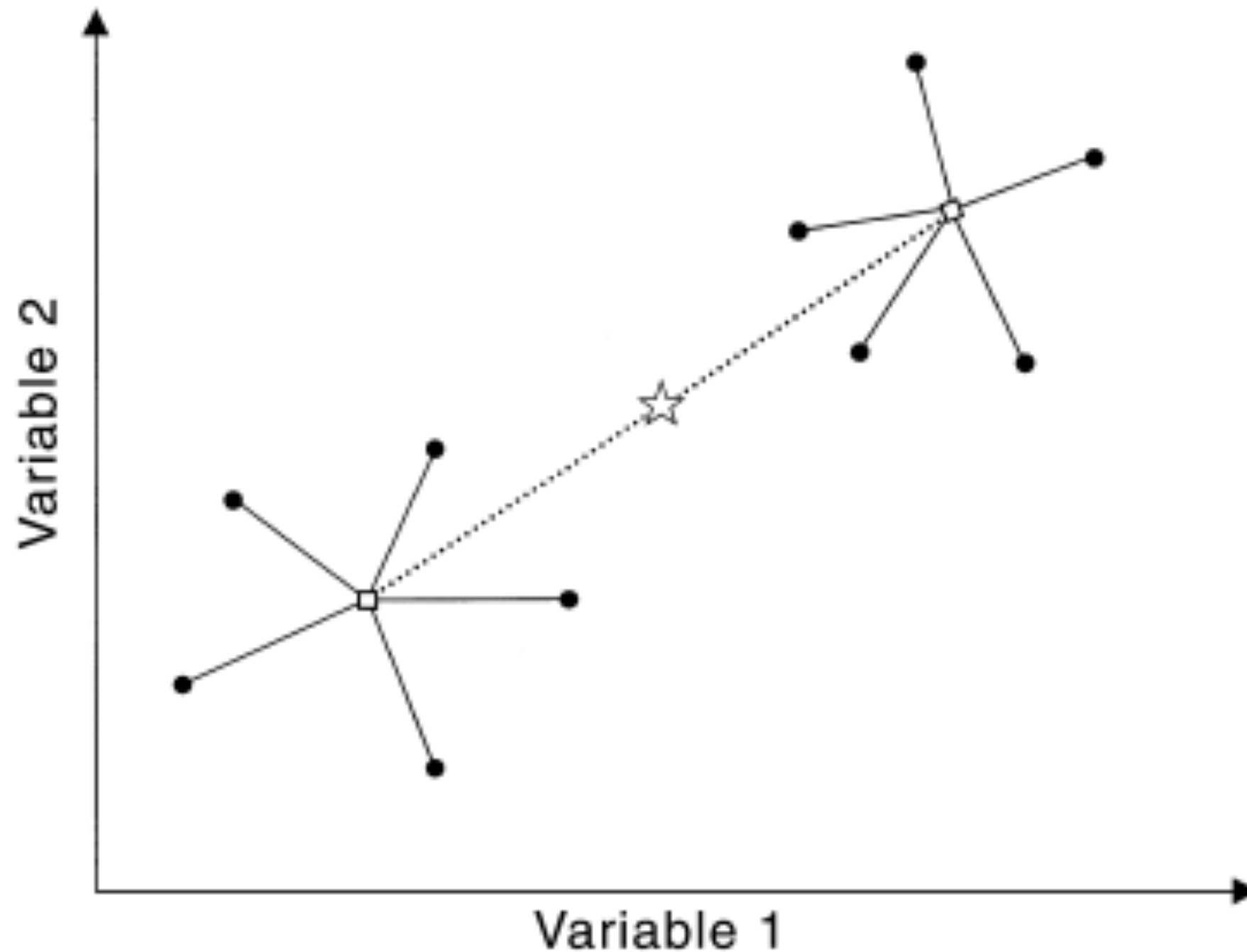


Non-Parametric Multivariate Tests

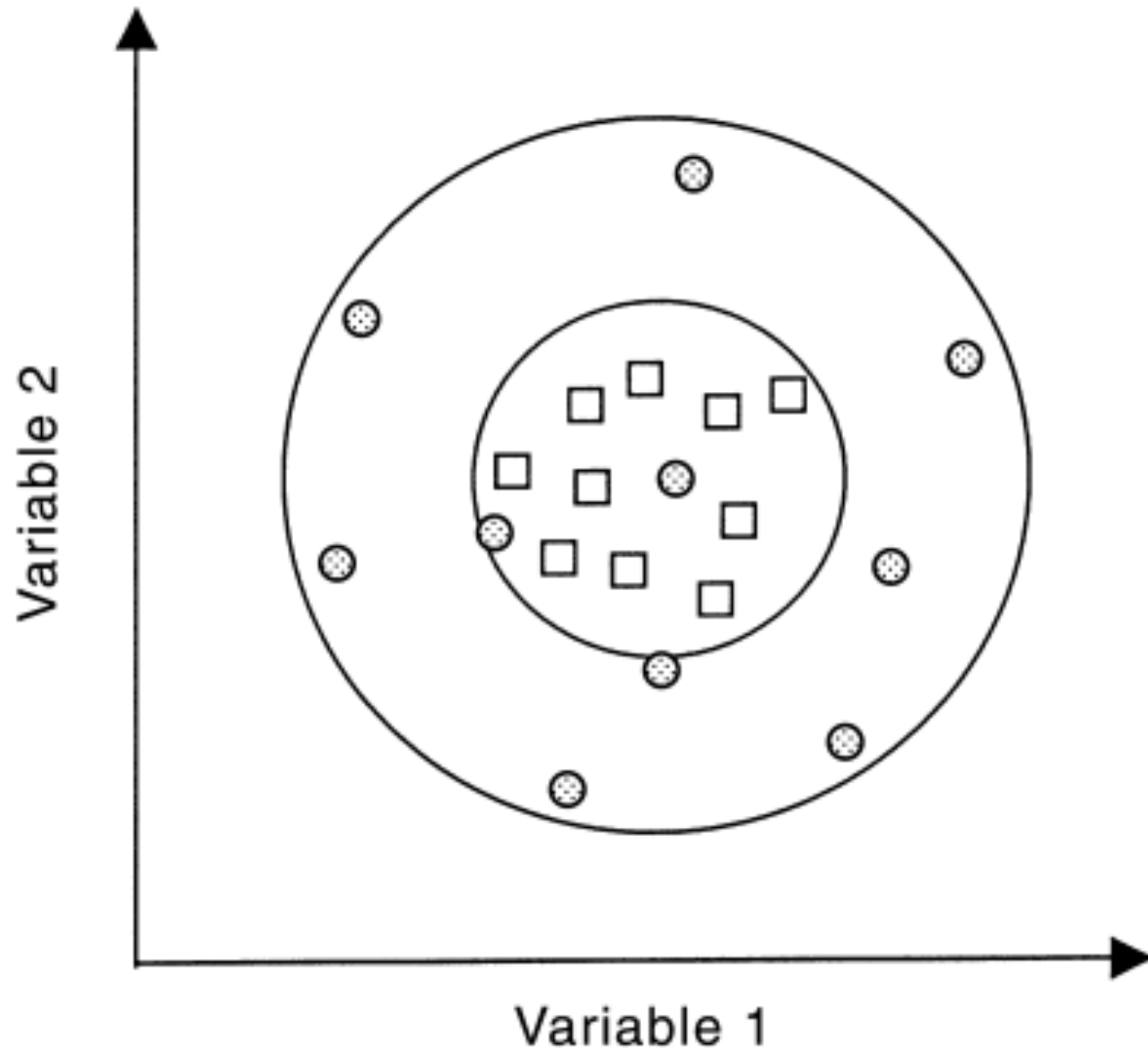


▲ Cats
○ Dogs
■ Rabbits

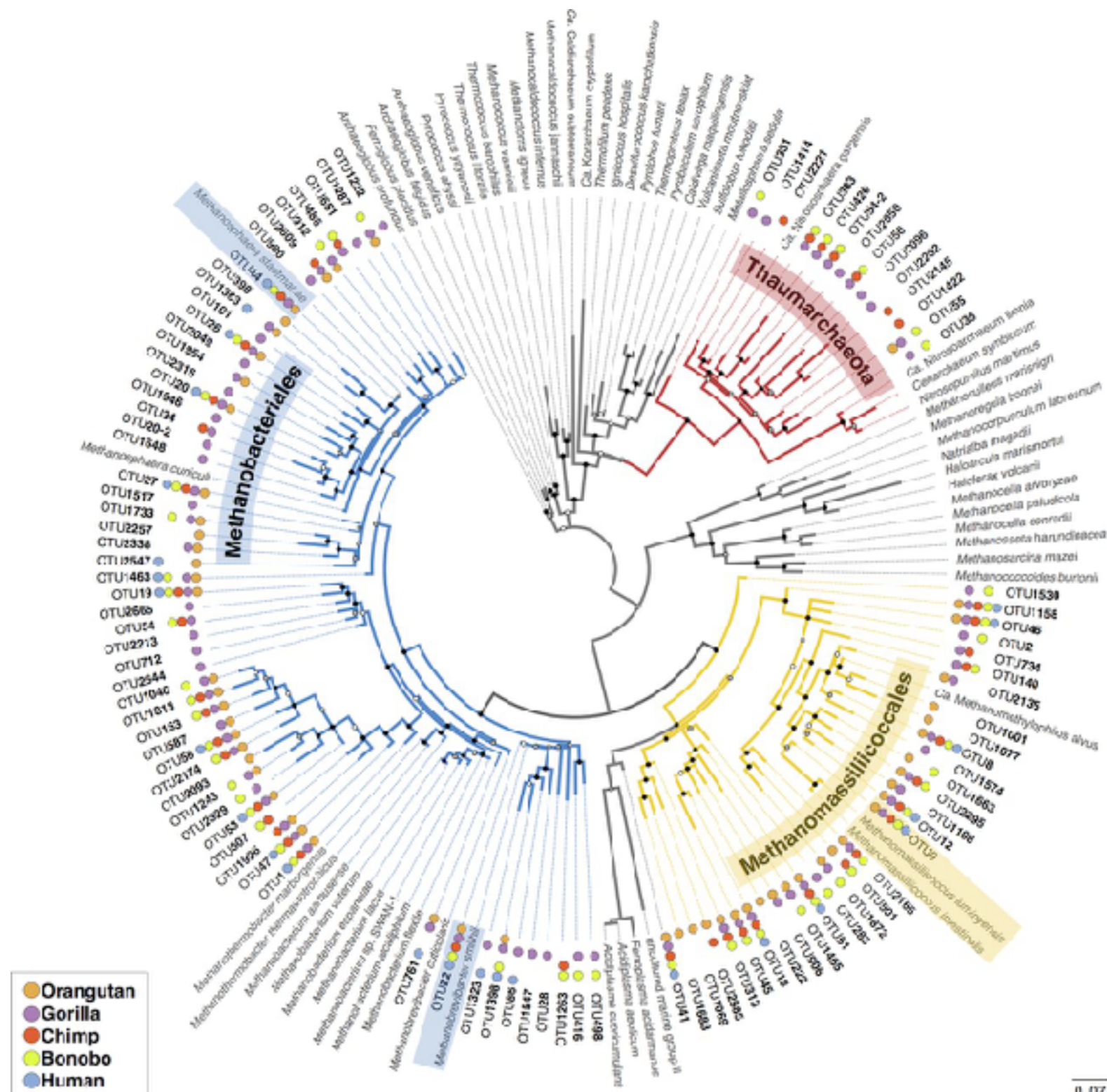
PERMANOVA



PERMANOVA Caveat



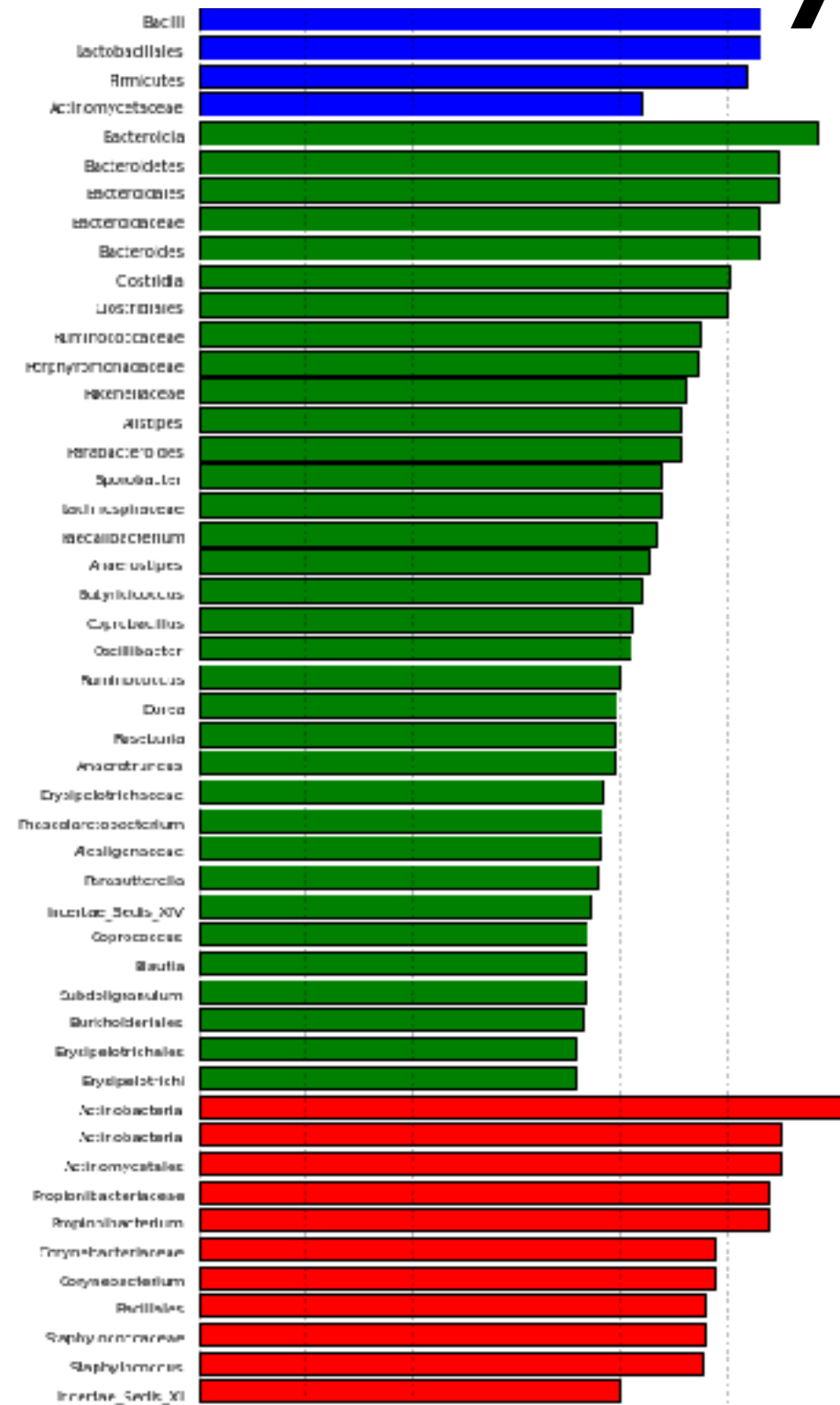
Phylogenetic Trees



Biomarker Discovery

- Question: Which OTUs* have different abundance between Site A and Site B

* or higher level taxonomic groups,



Biomarker Discovery

- LEfSe
- MetaBoot
- Metastats
- LIBSVM
- mRMR
- Regularized Low Rank-Sparse Decomposition (RegLRSD)

P >> N

	OTU 1	OTU 2	...	Meta 1	Meta 2	...
Sample 1						
Sample 2						
...						
Sample N						

P

N

Machine Learning

- Random Forests
- Support Vector Machines
- Kernel Ridge Regression
- Regularized Logistic Regression
- Bayesian Logistic Regression
- K-Nearest Neighbors
- Probabilistic Neural Networks
- etc