



# Ecological Statistics

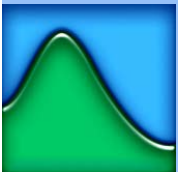
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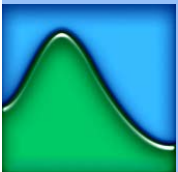
# Ecological statistics

- Tools for measuring biodiversity
  - Biodiversity – variety of life; different plants, animals and micro-organisms, their genes and ecosystems of which they are a part
- Many niche applications for measuring different components of biodiversity
  - Species richness estimation
  - Multivariate statistics for community analysis
  - Diversity and evenness measures
  - Add-ins for Excel
- GenStat
  - Set of procedures and menus providing tools for analysing ecological data



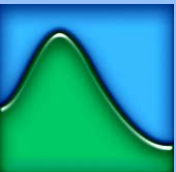
# Investigating species abundance

- Rank abundance plots
  - Also known as 'Whittaker plot'
  - Descriptive plot of relative abundances
  - Steep curves show high dominance
  - Shallow curves show higher evenness
- K-dominance plots
  - Descriptive plot of cumulative relative abundances
  - More elevation implies less diverse
- Abundance/biomass comparison (ABC)
  - Variant of k-dominance
  - Plot individuals against biomass



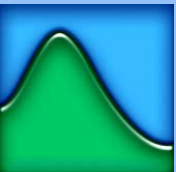
# Modelling species abundance

- Two forms of modelling
  - Statistical models
  - Niche (resource) apportioning models
- Statistical models
  - Poisson log-Normal (high evenness)
  - Log series (high dominance)
  - Negative binomial
  - Zipf & Zipf-Mandelbrot Higher evenness – Poisson-log normal



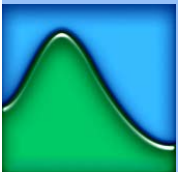
# Niche apportionment models

- Stochastic models simulating relative abundances
- Niche space is sequentially divided amongst species as they join the assemblage models
- Two step process
  - 1. Target niche is divided at random
  - 2. New target niche selected
  - Commands only (ECNICHE)
- Commands only – ECNICHE procedure



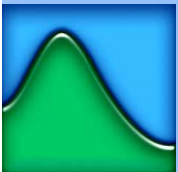
# Diversity indices

- Measure of species diversity with a community of co-occurring populations of two or more species
- Easy for scientists to understand
- Many different measures
  - Parametric and nonparametric
  - Each method has its own strength
  - Some emphasize richness component and others the evenness
- Jackknifing and bootstrapping to produce confidence intervals



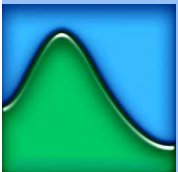
# How Many Species?

- Species accumulation curves
  - Collector curves – sequential sampling of individuals or pooling samples
  - Coleman 'random placement' curves
- Rarefaction
  - estimate the number of species that would be found if sampling effort was reduced to a specified level
  - Allows comparison amongst communities with unequal sampling
  - Individual- or sample-based



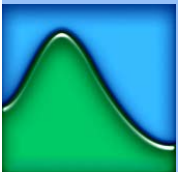
# Species richness estimation

- Nonparametric estimates
  - Many adapted from mark-recapture analysis
  - Bootstrapping for standard errors
- Parametric estimates
  - Log-series and Poisson log-Normal model for species abundance data
  - Model accumulation or rarefaction curve using FITNONLINEAR for models such as Michaelis-Menton or exponential



# Analysis of Similarities

- Method by Clarke (1993) also known as ANOSIM
- Nonparametric method to test for differences between two or more groups
- Permutation test on ranks of measures of similarities
- Calculates the difference between the between-groups and within-groups mean rank similarities
  - R statistic which lies between -1 and 1
  - Generally R is between 0 and 1
  - R = 0 implies no difference
  - R = 1 implies more similar within sites than between sites
  - R < 0 can occur when outliers present



# Other extensions

- Multivariate
  - Redundancy and partial redundancy analysis
  - Canonical correlation and partial canonical correlation analysis
- Coming soon...
  - Zero-inflated Poisson & negative binomial models
  - Other ideas?

