

BIOL 384 - Experimental Research in Biology

St. Francis Xavier University

Instructor

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Lectures

- Scientific method. Hypothesis testing in biology and ecology.
- Common statistical techniques in biology and ecology (including a review of concepts and techniques seen in introductory statistics courses)
 - Significance level, P value, Type I and Type II error rates, Power
 - Independent and paired t -test
 - One-way and two-way ANOVA – Multiple comparisons
 - Repeated-measures ANOVA
 - Analysis of covariance (ANCOVA)
 - Linear correlation
 - Model I simple linear regression (least squares)
 - Model II simple linear regression: reduced major axis (RMA) and principal components analysis (PCA) applied to bivariate data sets
 - Multiple linear regression
 - Nonlinear regression
 - Chi-square test
 - Resampling techniques (randomization test; bootstrap analysis)
 - Hotelling's T^2 test
 - Multiple analysis of variance (MANOVA)
 - Cluster analysis – Similarity coefficients
 - Principal components analysis (PCA) applied to multivariate data sets
- Application of those techniques in biology and ecology
 - Phenological studies
 - Population growth models
 - Allometry in plants and animals
 - Self-thinning dynamics
 - Phenotypic plasticity
 - Spatial population synchrony
 - Predator and prey behaviour
 - Feeding preference of herbivores and predators
 - Strength of ecological interactions in a community
 - Effects of multiple abiotic factors on populations and communities
- Sampling design
 - Shape and size of sampling unit
 - Sample size
 - Random, adaptive, and systematic sampling

Estimation of population density: quadrat counts, line transects, and distance methods
 Spatial pattern analysis: methods to estimate spatial pattern, indices of dispersion

- Experimental design: basic principles
 - Mensurative vs. manipulative experiments
 - Field vs. laboratory experiments
 - Snapshot vs. trajectory experiments
 - Press vs. pulse experiments
 - Controls and randomization
 - Replication and pseudoreplication
 - Balancing and blocking
- Experimental design: types
 - Linear additive models
 - Factorial design
 - Randomized block design
 - Nested design
 - Split-plot design
 - Repeated-measures design
 - Environmental impact (BACI) design

Laboratories and Tutorials

Lab time will be used for the following activities:

- Discussion of published papers on the logic of the scientific method, application of statistical techniques, and sampling and experimental design
- Practice of statistical techniques in computer labs
- Oral presentations of a literature research project

Final mark break-up

Exams: 60 % (two midterms –3 February and 9 March– and a final exam in April)
 Laboratories and Tutorials: 20 %
 Literature research project: 20 %

Course Literature

Main textbook:

Howell, D. C. (any edition since 1992). Statistical methods for psychology. Duxbury.

Also:

Gotelli, N. J. & A. M. Ellison (2004). A primer of ecological statistics. Sinauer.

Krebs, C. J. (1999). Ecological methodology. Addison Wesley Longman.

Scientific papers available in the course's website: <http://people.stfx.ca/rscrosat/biology384>