Course Overview: Quantitative Methods in Marine Science

Prerequisites

- Data types
- Descriptive vs Inferential Statistics
- Measures of Dispersion & Central tendency
- Data exploration & making graphs
- Distributions & Probability
- Estimators
- Key Statistical Concepts & hypothesis testing
- Discrete vs Continuous Variables
- Anova/ Ancova/ Regression
- Basics of experimental design: Replication, Randomness & Independence

Overview – Linear Models

Complexity

General Linear Models:
- normal error

$$Y_i = \beta_0 x_{0i} + \beta_1 x_{1i} + \ \ldots + \boldsymbol{\varepsilon_i}$$

Generalized Linear Models:
- Poisson/ binomial error
- Link function

$$\boldsymbol{f(Y_i)} = \beta_0 x_{0i} + \beta_1 x_{1i} + \ldots$$

Linear Mixed Models:
- Random effects

$$Y_i = \beta_0 x_{0i} + \beta_1 x_{1i} + \cdots \boldsymbol{b_{ij}} + \varepsilon_i$$

Course Content

1. Introduction
- General concept of a statistical test
- Overview of important probability distributions
  - Normal, Binomial & Bernoulli, Poisson
- Estimation procedures
  - Least Squares Estimators
  - Maximum Likelihood Estimators
- Overview of the most important test procedures
  - Wald/t-test & t-test
- Anova Review

2. General Linear Models
- GLM formulation
- Parameter estimation
- Estimating means
- Statistical tests concerning the parameters
  - One parameter: t-test
  - Multiple parameters: F-test
- Testing assumptions & remedial measures
- Applications of linear models
  - Linear/multiple regression
  - One-way/two-way/multi-way Anova
  - Ancova
  - Complex models

3. Generalized Linear Models
- Formulation
- Estimation & statistical testing of model parameters
  - Testing one parameter: Wald test
  - Multiple parameters: likelihood ratio test
- Estimation of predicted responses
- Testing assumptions
  - Lack-of-fit test
  - overdispersion
- Examples: logistic & poisson regression

4. Mixed Linear Models
- Formulation
- Fitting linear mixed models
- Key concepts: Variance-covariance-correlation
- Analysis of repeated measures

5. Multivariate Analysis
- Cluster Analysis
- Multidimensional scaling
- ANOSIM
- BIOENV
- SIMPER
- Permanova

IMBRSea Compass 2019