

# Data & Analysis in Natural Sciences

[Data Analysis Nat Sci]

## SYLLABUS

3 credits

FALL 2015

GLY6932/GLY4930 || ZOO6927/ZOO4926

**Instructor:** Michal Kowalewski ([kowalewski@ufl.edu](mailto:kowalewski@ufl.edu)), Dickinson 254 (Tel: 352-273-1944)

**Lectures:** WM 265, MW (3), 9:35am-10:25am

**Labs:** WM 265, W (6-7), 12:50am-2:45pm

**Prerequisites for Graduate Students:** None

**Prerequisites for Undergraduate Students:** Consent of the instructor

**Textbook Required:** None (Readings will be assigned and provided in class)

**Freeware:** R

**Hardware:** Laptop is required for lab meetings

**Synopsis:** This course will combine lectures and hands-on lab activities with focus on practical applications of classic statistical methods in natural sciences. Examples will primarily derive from ecology, paleobiology, and geological sciences. Lab sessions will provide practical training in using R for data processing and analyses. The course will consist of self-contained modules built around empirical examples. Although some of the topics are inherently biological, many aspects of the course should be transferable to other disciplines of natural sciences. This course will provide intuitive (rather than mathematical) introduction to common methods used in natural sciences to analyze empirical and experimental data. The course will NOT cover phylogenetic methods.

### Topical Overview

| Segment  | Content  |
|--|--|
| S1: Introductory Materials                                       | Data, variables, data reporting, data transformations and standardization, univariate descriptors, hypothesis testing  |
| S2: Interactions between Two Variables                           | Bivariate plots, covariance, correlation, and regression   |
| S3: Ordinations: Exploring multivariate data in natural sciences | Exploratory methods: PCA, PCO, nMDS, CA, DCA, CCA, CVA<br>Confirmatory methods: MANOVA, MANCOVA, Permutation tests,<br>Classificatory methods, Discriminant functions  |
| S4: Measuring diversity  | Diversity indices, RAD models, alpha-beta-gamma, sampling standardization methods (rarefaction, Jackknife, shareholder quorum, etc.), preview of disparity   |
| S5: Resampling strategies in natural sciences                    | Randomization, bootstrap, jackknife, subsampling, Monte Carlo models   |
| S6: Additional Topics*   | Examples: Size and shape (body size, allometry, heterochrony)<br>Morphometrics and morphological diversity. Time series and autocorrelation, correcting for multiple tests, angular and other non-ratio variables, scaling phenomena (evolutionary rates, net sedimentation rates) |

\*Additional topics may be covered time permitting

# Schedule

## Schedule

|                |               |                          |   |
|----------------|---------------|--------------------------|---|
| Week 01: 08/24 | <del>MW</del> | ( <del>W</del> —no Labs) |   |
| Week 02: 08/31 | MW            | (W - Lecture)            |   |
| Week 03: 09/07 | <del>MW</del> | (W - Lab 1)              | (No Monday Lecture – Holiday)                   |
| Week 04: 09/14 | MW            | (W - Lab 2)              |   |
| Week 05: 09/21 | MW            | (W - Lab 3)              |   |
| Week 06: 09/26 | MW            | (W - Lab 4)              |   |
| Week 07: 10/05 | MW            | (W - Lab 5)              |   |
| Week 08: 10/12 | MW            | (W - Lab 6)              |   |
| Week 09: 10/19 | MW            | (W - Lab 7)              |   |
| Week 10: 10/26 | MW            | (W - Lab 8)              |   |
| Week 11: 11/02 | <del>MW</del> | ( <del>W</del> —no Labs) | (No Labs or Lectures; MK at a conference)       |
| Week 12: 11/09 | <del>MW</del> | ( <del>W</del> —no Labs) | (No Labs or Lectures; holiday)                  |
| Week 13: 11/16 | MW            | (W - Lecture)            |   |
| Week 14: 11/23 | <del>MW</del> | ( <del>W</del> —no Labs) | (Thanksgiving Holiday, no W lecture, no W labs) |
| Week 15: 11/30 | MW            | (W - Lecture)            |   |
| Week 16: 12/07 | MW            | ( <del>W</del> —no Labs) |   |

## Lecture Topics

- Lecture 1: Scientific Methods
- Lecture 2: Type of Research in Natural Sciences
- Lecture 3: Types of Data
- Lecture 4: Hypothesis Testing
- Lecture 5: Univariate Tests (Part 1)
- Lecture 6: Univariate Tests (Part 2)
- Lecture 7: Bivariate Methods
- Lecture 8: Multivariate Ordinations (Part 1)
- Lecture 9: Multivariate Ordinations (Part 2)
- Lecture 10: Multivariate Ordinations (Part 3)
- Lecture 11: Multivariate Ordinations (Part 4)
- Lecture 12: Multivariate Tests (Part 4)
- Lecture 13: Resampling Methods
- Lecture 14: Diversity (Part 1)
- Lecture 15: Diversity (Part 2)
- Lecture 16: Scaling and Time Series

## Labs

Tutorials and exercises in R (8 Assignments)