Leon H. Charney School of Marine Sciences
UNIVERSITY OF HAIFA

Experimental design, data collection and scientific analysis – 4 credits

Course Number: 221.4020

Lecturer: Prof. Nir Sapir

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Course Type: Lectures, class exercises, excursions

Course Level: MSc

Prerequisites: Introduction to Statistics

Course Description:

The course is designed to acquire the student skills for biological experimental design, sampling, and data collection in the lab and the field, data analysis and graphical representation, and reaching statistically sound conclusions. By the end of the course, it is expected that the student will be able to independently explore, test, and conclude about his research findings using statistical tools. The topics of the course include the planning of a study by asking good scientific questions, the basics of sampling design, sampling from a population, measures of central tendency and dispersion, normality, transformations, linear regression, multiple regression, t-tests, ANOVAs, and ANCOVA, Chi-square for goodness of fit and independence, multiple regression, logistic regression, survival analysis, spatial distribution, richness and diversity, non-parametric alternatives to parametric tests.

Topics:

1. Introduction, review of statistical theory and first acquaintance with SPSS.
2. Model research plan.
3. Sampling theory.
4. Statistical hypotheses, normality, transformations, and non-parametric tests. Tests to compare two means (t-test and non-parametric tests).
5. Type I and II errors, Pearson's and Spearman's correlation coefficients, and simple linear regression.
6. Multiple regression.
7. One-and two-way ANOVA, interactions and their importance, ANCOVA.
8. GLM, GAM, Mixed models.
9. Chi-square, goodness of fit.
10. Models of spatial spread for a single species, nearest neighbor.
11. Data sampling and application of statistical analyses.

12. Logistic regression, cox regression (survival analysis).
13. Field sampling methods and results.

Learning Outcomes:

At the end of the course, students will be able to:

1. Understand how sampling should be planned and executed.
2. Know how to analyze data in SPSS and illustrate figures in MS Excel.
3. Know how to choose appropriate statistical analysis.
4. Know a wide variety of statistical tests that can be applied under different circumstances.
5. Understand when parametric vs. non-parametric tests should be applied.
6. Infer about experimental design, statistics, level of significance, and statistical conclusions.

Requirements and grading:

1. Home exercises (40%).
2. Final exercise (10%).
3. Final exam (50%).

Reading List:

1. Grafen, A. and Hails, R. 2002. Modern Statistics for the Life Sciences. Oxford.
2. Field, A. 2005. Discovering Statistics Using SPSS. Sage. London.
3. Sokal, R.R. and Rohlf, F.J. 1995. Biometry. 3rd Edition. Freeman.
4. Southwood, R. 2000. Ecological Methods. Blackwell Science, Oxford. 3rd Edition.
5. Sutherland, W.J. 1996. Ecological Census, Techniques. Cambridge University Press.
6. Underwood, A.J. 1997. Experiments in Ecology. Cambridge University Press.
7. Zar, J.H. 1999. Biostatistical Analysis. 4th Edition. Prentice Hall.