# 221.4020 Experimental Design, Data Collection and Scientific Analysis Semester A

**Time:** 15:00-19:00, Mondays, Room 577 computer rooms complex, main building

**Instructor:** Prof. Nir Sapir, **Email:** nirs@sci.haifa.ac.il

**Office Hours:** Upon request, Room 108 Beit Sala Building, 04-6647966

**Teaching Assistants & Office Hours:**

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**Course Level:** M.Sc.

**Course Type & Format:** Lectures, class exercises, excursions

**Number of Hours/Credits:** 4 credit points

**Prerequisites:** Introduction to Statistics

**Course Overview (Short Abstract):** The course is designed for aacquiring the student skills for biological experimental design, sampling and data collection in the lab and in 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.

**Learning Outcomes (What are the skills, abilities, or major concepts a student is expected to acquire in this course?) – At the end of the course students will be able to:**

1. Understand how sampling should be planned and executed
2. Know how to analyse 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

**Assessment (Assessment Method and Grade Composition):**

Home exercises (40%)
Final exercise (10%)
Final exam (50%)

**Week-by-Week Content and Assignments:**

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

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| 12 | Lecture: Logistic regression, cox regression (survival analysis) | Home exercise |
| 13 | Presentations: Field sampling methods and results | Field excursion presentation, Home exercise |
| 14 | Lecture: Course summary | |

**Website:** Moodle website

**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.