Biostatistics
1-2-3021

3 Credits

Albert Katz International School for Desert Studies

(graduate level course for students in experimental sciences. E.g. ecology, argobiology, biothechnology, hydrology)

2 lecture hours, 2 hours lab, 3 credit points

Prerequisites

* A basic course in probability and statistical inference (including simple linear regression).

* Familiarity with Excel.

Course summary

This course is an advanced course in statistics and experimental design. The goal of the course is to provide research students in experimental sciences with a wide set of statistical tools and the experience in applying them. It includes a brief introduction to statistical inference and a wide range of linear models including ANOVA, regressions, experimental designs and diagnostics. The focus will be on parametric test, but non-parametric tests will be presented as well. A few lectures will be devoted to more advanced topics (e.g. generalized linear models, model selection, survival analysis), depending on students' interest and research need.

Syllabus for Biostatistics course: 2022-2023

Weeks - lectures – topics

- This plan below may change slightly according to our progress and special interest by the students; Especially there are two weeks left for advance topics of your choice/suggestion.

1. Week 1 – **Intro, Descriptive statistics, sampling**
    a. Topics: General Introduction, catching up, descriptive statistics, sampling, biases in sampling, general purpose of using statistics
    b. Very brief instructions for R, R-studio and swirl
2. Week 2- **Hypothesis testing and Comparisons of two populations.**
    a. Lecture Topics: hypothesis testing, comparison of two populations.
        i. Equal variance vs. unequal variance
        ii. Comparing variances
        iii. Paired vs. unpaired
3. Week 3 – **Linear models + 1-way ANOVA**
    a. Topics: General idea of liner models. Structure, what's between regression and factorial (ANOVA) analysis.
4. Week 4 – **Linear regression, multiple regression, correlations**
    a. Review of linear regression
    b. Multiple linear regression
    c. Polynomial regression
    d. Model selection and Hierarchical partitioning
    e. Correlations (Pearson and Spearman)
5. Week 5 – **Two-way ANOVA and introduction to mixed models**
    a. Topics: Fixed factor, Random factor, Interaction terms, Models I, II, and III ANOVA
    b. The link between ANOVA model, partitioning of the variation and goodness of fit. Constructing F-statistic for ANOVA models
6. Week 6 – **Multiple comparisons, Data transformation, and Non-parametric tests**
    a. Topics: A-priori and posteriori multiple comparisons, Simple data exploration and various remedies for violation of normality assumption.
7. Week 7 – **Experimental design – 1**
    a. Topics: Completely Randomized Designs, Randomized Bock Design, Nested design
    b. replication, blocking, stratification
8. Week 8 – **Experimental design – 2.**
    a. Topics: Repeated measure, Split plot design
9. Week 9 – **Data exploration, graphical presentations and statistical distributions**
    a. Topics: A **very** brief introduction to the concepts of Random variables, probability distributions, Likelihood, maximum likelihood, and likelihood ratio test.
10. Week 10 – **Generalized linear model**
    a. Topics: Constructing complex statistical models, Generalized linear models (GLZ): "breaking loose of all limiting assumptions" Model structuring, model choice. Poisson regression, logistic regression,

multinomial regression. Poisson regression, logistic regression, multinomial regression

11. Week 11 – **Categorical data analysis**
    a. Topics: Chi-square, G-test and log-linear models
12. Weeks 12,13 – **Advanced topics**
    a. Topics: These may include: survival analysis, ANCOVA, A brief introduction to multivariate analysis, Advance plotting and presentation in R, etc.

Texts

Murray Logan: Biostatistical Design and Analysis Using R.

Gotelli, N.J., A.M.Ellison. Primary of ecological statistics. Sinauer Associates, Inc.

Students with lacking background will be assigned additional readings and exercises.

Software

We will mainly use R, R-studio and JAMOVI.

Requirements

Bi-weekly homework and reading is required.

Grading

Homework assignments: 40%, final exam: 60%