TEL AVIV UNIVERSITY אוניברסיטת תל אביב

Full Syllabus

Course Title

Biostatistics

Lecturer

Roi Holzman, Shay Rotics

Semester

Fall

Course requirements

An introductory course to statistics (0455.1806)

Final grade components

Weekly assignments (45%) and final exam (55%)

Course schedule

Class no. / Date	Subject and Requirements (assignments, reading materials, tasks, etc.)
Week 1 (Roi)	**Introduction**: About the course; Course objectives; Why we use R; Organizing data for use in R.
Week 2 (Roi)	**Graphics**: The purpose of data visualization: Principles of effective visualization; Types of plots to achieve these principles; How some plots fail, and what can be done; What about tables?
Week 3 (Roi)	**Experimental design**: Plan your sample size; Experiments vs. observational studies; Why do experiments?; Clinical trials: experiments on people; Design to minimize bias and effects of sampling error; Analysis Follows Design; What if you can't do experiments.
Week 4 (Roi)	**Basics of hypothesis testing**: What is a hypothesis test? Example with binomial and t-test; The importance of checking assumptions; Difference between parametric and non-parametric tests; Types of data and tests that (might) suit them.
Week 5 (Roi)	**The General Linear model**: What is a General linear model?; Several examples; Estimating parameters vs. testing hypotheses; Model comparison: full vs. nested models; Sequential vs. marginal testing of terms; The lure of model simplification; Perils of correcting for covariates; Assumptions of linear models; Related methods in R. Post hoc tests, and correctly recovering model coefficients.
Week 6 (Roi)	**Mixed-effects models**: Random vs. fixed effects; Two-factor ANOVA example; Why are the calculations are different with random effects?; Unbalanced designs with random effects; Examples of experiments with random effects; Linear mixed-effects models; Example: Estimating repeatability of a measurement; Assumptions of linear mixed-effects models; An example violating the assumptions, with solutions.
Week 7 (Shay)	**Likelihood**: Probability and likelihood; Maximum likelihood estimation; Example: estimate a proportion; Likelihood works backward from probability; Likelihood-based confidence intervals; Example: estimate survival rates; Log-likelihood ratio test; Example: test a proportion.

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Week 8 (Shay)	**Generalized linear models**: What is a generalized linear model; Linear predictors and link functions; Example: estimate a proportion; Analysis of deviance table; Example: fit dose-response data using logistic regression; Example: fit count data using a log-linear model; Example: model contingency tables; Advantages and assumptions of GLM; Quasi-likelihood modeling when there is excessive variance.
Week 9 (Shay)	**Model comparison:** Example: polynomial regression; The problem of model selection; Choose among models using an explicit criterion; Goals of model selection; Criterion: AIC; Example: predicting ant species richness; Search strategies: dredge(), stepAIC(); Several models may fit about equally well; The science part: formulate a set of candidate models.
Week 10 (Shay)	**Bootstrap and resampling**: Estimation and hypothesis testing; Permutation test; using bootstrap for error estimation; The sampling distribution; The bootstrap standard error; The bootstrap confidence interval; Comparing two groups; parametric vs. a-parametric bootstrap; jackknife; when not to bootstrap.
Week 11 (Guest lecture)	**Bayesian data analysis:** What is probability; Another definition of probability; Bayes Theorem; Prior probability and posterior probability; How Bayesian inference is different from what we usually do; Example: one species or two; Example: estimate a proportion; Credible intervals; Bayes factor; Bayesian model comparison; Posterior predictive checks.
Week 12 (Roi)	**Multivariate statistics:** Why do a multivariate analysis?; Ordination, classification, model fitting; Principal component analysis; Discriminant analysis, quickly; Species presence/absence data; Distance data.
Week 13 (Roi)	**Species as data points:** Example: the problem with species data; Phylogenetic signal in ecological traits; Why phylogeny matters in comparative study; Phylogenetically independent contrasts; A linear model (general least squares) approach; An embarrassment of riches.

Required course reading

Optional course reading

Comments