

Advanced Statistics

Prof. Antonietta Mira - A.Y. 2023-2024

Course description

The aim of the course is to introduce the students to some advanced statistical methods.

Contents

Hypothesis testing. Generalities on hypothesis testing. Error Probabilities. Power function. Level and size of the test. Most powerful tests. Likelihood-ratio tests. P-values.

Survival analysis. Generalities on survival data. Survival and hazard functions. Censoring and truncation. Nonparametric inference for Right-Censored and Left-Truncated Data. Kaplan-Meier and Nelson-Aalen estimators. Testing statistical hypotheses on the survival function. Log-rank tests. Regression analysis. Accelerated failure time. Proportional Hazards regression. Inference: partial likelihood and profile likelihood. Model diagnostics.

Longitudinal analysis. Longitudinal designs. Dynamic and static effects. Mixed effects model. De-meaning. Least squares dummy variables. Random effects. MLE estimators. GLM extension.

Bayesian statistics. Bayesian paradigm. Prior and posterior distributions. Conjugate analysis. Prior elicitation. Decision theoretic foundations. Bayesian estimators. Credible regions. Hypothesis testing and model comparison/selection. Basics of Bayesian computation and Markov chain Monte Carlo methods.

Performance assessment

Oral exam. In the first part of the oral exam, the students will present a theoretical or an applied project. In the second part, questions on the contents of the course will be asked.

Adopted texts

Agresti, A. and Ketari, M. (2021). *Foundations of Statistics for Data Scientists: With R and Python*. Chapman and Hall/CRC.

Diggle, P. J., Heagerty, P., Liang, K., and Zeger, S. L. (2002). *Analysis of Longitudinal Data*. Oxford University Press.

Gelman, A., Carlin, J. B., Stern, K. S., Dunson, D. B., Vehtari, A., and Rubin, D. B. (2014). *Bayesian Data Analysis*. Chapman & Hall.

Klein, J. P. and Moeschberger, M. L. (2003). *Survival analysis, Techniques for Censored and Truncated Data*. Springer.