105.692 Introduction to Statistics

VO, 3.0h, 4.5EC

Summer 2021

Instructor:	Prof. Efstathia Bura	**Time:**	W 10:00 – 12:15
Email:	efstathia.bura@tuwien.ac.at	**Place:**	online (TUWEL Zoom)

Course registration: In TISS and TUWEL.

Course Pages: All course material and further course information can be found in TUWEL under

https://tuwel.tuwien.ac.at/course/view.php?idnumber=105692-2021S

References:

- F. Abramovich and Y. Ritov, *Statistical theory : a concise introduction*, CRC Press, 2013.
- G. Casella & R. L. Berger, *Statistical Inference* (2nd Edition), Wadsworth & Brooks/Cole Advanced Books & Software, 2002.
- L. Wasserman, *All of Statistics: A Concise Course in Statistical Inference*, Springer, 2004.
- M. Messer und G. Schneider, *Statistik: Theorie und Praxis im Dialog*, Springer, Berlin (available online in the TU library)
- U. Krengel, Einführung in die Wahrscheinlichkeitstheorie und Statistik, Vieweg Wiesbaden.
- Y. Pawitan, *In All Likelihood: Statistical Modelling And Inference Using Likelihood*, Oxford University Press, 2001.

Objectives and course outline: This is a one-semester course covering basic statistical theory such as distribution theory, point estimation, hypothesis testing, asymptotic theory and their applications.

- Probability theory: probability spaces, calculating probabilities, Bayes theorem, discrete and continuous random variables, distributions (Bernoulli, binomial, geometric, Poisson, uniform, normal and exponential distributions), quantiles, moments, mean and variance, independence, conditional probability, covariance, correlation, independence, multiple random variables, convergence concepts, law of large numbers, central limit theorem.
- Descriptive Statistics: elementary statistics, empirical distribution, graphical representations (frequency table, diagrams, histograms, scatterplots).
- Inferential statistics: Significance tests and confidence intervals (one- and two-sample z-tests and t-tests), p-value, significance level, α- and β-errors, nonparametric tests (goodness-of-fit tests, chi-square tests for homogeneity and independence), classical point estimation (parametric and non-parametric methods), analysis of variance, linear models.
- Applied aspects (calculations, simulations, visualizations, analyses) are implemented in the statistical software `R`.

Prerequisites: Basic knowledge of probability theory, linear algebra and calculus.

Accompanying exercise course (UE): 105.693

Grading Policy: The course grade is based on a written comprehensive multiple choice final exam.

Important Dates:

Exam #1 ..... June 29, 2021
Exam #2 ..... October 1, 2021
Exam #3 ..... December 2, 2021

Attendance:

- Attendance is not mandatory but essential for your successful completion of the course.

Tentative Schedule:

Lecture	Date	Topic
1	March 3	Probability spaces, independence, conditioning, Bayes theorem
2	March 10	Random variables, bivariate, marginal, conditional, independence
3	March 17	Common families of distributions, Moments and moment generating functions
4	March 24	Multiple random variables, correlation and covariance, transformations
		Easter Break March 29 - April 9
5	April 14	Probability inequalities, convergence of random variables, central limit theorem, law of large numbers
6	April 21	Conditional expectation and variance, Point estimation
7	April 28	Large sample theory, consistency and normality of MLE
8	May 5	Fisher information and Cramer-Rao lower bound, Confidence intervals
9	May 12	Sufficient statistics, Exponential family of distributions
10	May 19	Descriptive statistics, Hypothesis testing
11	May 26	One-sample t-test, two-sample t-test
12	June 2	Analysis of variance and multiple testing
13	June 9	Linear regression
14	June 16	Proportions, χ^2-test (goodness of fit, independence)
15	June 23	Review