107.254 Statistics and Probability Theory

VO Lectures, 2.0h, 3.0 EC

Winter semester 2023/24

Lecturer:	Tijana Levajković	**Time:**	Mon 09:15 – 11:00
Email:	tijana.levajkovic@tuwien.ac.at	**Place:**	Informatikhörsaal - ARCH-INF
Contact:	Institute of Statistics and Mathematical Methods in Economics	**Office:**	DB 04 B24 (Freihaus, 4.floor, yellow) Freihaus, 4. floor, yellow
Web:	https://tiss.tuwien.ac.at/person/321365.html?suchtext=levajkovic/		

Course registration: In TISS

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

Overview: This lecture offers an introduction to probability theory and statistics. The contents are presented in the course and applied and deepened in the accompanying exercises.

Prerequisites:

- Successful completion of STEOP.

- Basic knowledge of linear algebra and calculus.

- Registration in the course within the registration period (from 04.09.2023, 7:00 until 10.10.2023, 12:00). Deregistration is possible until 31.10.2023.

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

- Probability theory: counting (multiplication rules, permutations, combinations), computing probabilities and conditional probabilities, Bayes theorem, discrete and continuous random variables, distributions (Bernoulli, binomial, geometric, Poisson, uniform, normal and exponential distributions), computing moments of random variables, expectation and variance, quantiles, independence, covariance, correlation, 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 (also called errors of Type I and Type II), non-parametric tests (goodness-of-fit tests, chi-square tests for homogeneity and independence), analysis of variance, multiple comparisons.

- Linear regression (correlation, simple linear model, regression line, coefficient of determination).

Applied aspects (calculations, simulations, visualizations, analyses) are implemented in the statistical software R.

Literature:

- L. Fahrmeir, C. Heumann, R. Künstler, I. Pigeot, G. Tutz, *Statistik – Der Weg zur Datenanalyse.* Springer, Berlin Heidelberg (available online via TU library).

- J. Hedderich und L. Sachs, *Angewandte Statistik – Methodensammlung mit R.* Springer, Berlin, Heidelberg (available online via TU library)

- N. Sharpe, R. De Veaux, P. Vellemann, *Business Statistics.* Pearson, Boston.

- G. Kersting und A. Wakolbinger, *Elementare Stochastik*, Birkhäuser, Basel (available online via TU library).

- M. Messer und G. Schneider, *Statistik: Theorie und Praxis im Dialog.* Springer, Berlin (available online via TU library).

- W. Gurker, *Statistik und Wahrscheinlichkeitstheorie.* TU-Verlag, Vienna (available purchasable in Grafisches Zentrum)

- U. Krengel, *Einführung in die Wahrscheinlichkeitstheorie und Statistik*, Vieweg Wiesbaden.

Tentative Schedule:

Lecture	Date	Topic
1	October 2	Course description & Introduction to probability theory (counting, permutations, combinations, computing probabilities)
2	October 9	Conditional probability and the Bayes rule
3	October 16	Random variables and distributions
4	October 23	Distributions and their properties: Bernoulli, Binomial, geometric, Poisson, uniform, exponential and normal
5	October 30	Central Limit Theorem (CLT) & Law of Large Numbers (LLN)
6	November 6	Review Part 1
7	November 13	Descriptive statistics
8	November 20	General idea of hypothesis testing
9	November 27	Surrounding the one-sample t-test
10	December 4	Surrounding the two-sample t-test
11	December 11	Analysis of variance and multiple testing
12	December 18	Linear regression
	December 22 - January 5	Christmas Break
13	January 8	Proportions
14	January 15	Chi-square tests (goodness of fit/ independence)
15	January 22	Review Part 2
	January 29	**Exam 1**

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

Grading Policy: The course grade is based on a written comprehensive final exam comprising of multiple choice problems from the topics covered in the course.

Important Dates:

Exam 1 .... January 29, 2024
Exam 2 .... February 27, 2024
Exam 3 .... May 7, 2024

Exam registration: in TISS within the registration period. If you are registered for the exam and are not going to attend it, please DEREGISTER in TISS within the deregistration period. Please note that students who do not deregister and do not attend the exam will be BLOCKED for registrations for the following examination term.

Academic integrity: Students in this course are expected to comply with the academic integrity code and to behave with academic honesty. Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information.

Plagiarism: All your submitted work should be result of your own thought and research.
We take plagiarism seriously; students who are caught plagiarizing will fail the course.

Alternative in summer semester: The course 107.273 Statistics and Probability Theory offered in summer semester is usually less frequented.