Department	VI – Informatics and Media / *Informatik und Medien*
Degree level	Master's
Degree program	Data Science / *Data Science*
Type of instruction	Seminar plus computer exercises
Credits	5
Availability	Winter semester
Hours/week	4

Module Number	M01
English/German Title	Mathematical Models / Mathematische Modelle
Credit Points	5 credits
Workload	150 hours: • Class attendance 4 h/w during the semester lecture period: 68 hours • Independent study: 82 hours
Subject Coverage	Subject-specific specialization
Learning Objectives / Outcomes	Students will acquire deep understanding of linear algebra, analysis of real functions and probability calculus. The main focus lies on the transfer of the necessary basics for modeling multi-dimensional and high-dimensional data. This includes, in particular, the examination of multidimensional vector spaces, the optimization of multidimensional functions, and the investigation of characteristic properties of random vectors. The illustration of the concepts should be carried out directly with suitable statistical and data analysis software.
Prerequisites	Recommendation: Fundamentals of Mathematics in Bachelor's degree
Level	1st semester
Type of Module	Seminar plus computer exercises
Status	Required module
Semester when Offered	Winter semester
Method of Assessment / Type(s) of Examination	The method of assessment / type of examination(s) must be defined by the lecturer within the deadline determined in §19 (2) RSPO. Should the deadline pass without determination of the form of assessment in the module, the following method of assessment / type of examination applies: Examination 100%.
Determination of the Grade	See study and examination regulations
Equivalent Modules	Modules of comparable contents
Contents	Elements of Linear Algebra and Analysis • Deepening of fundamentals in vector algebra. Vectors and scalars, arithmetic operations, linear independence, base/foundation, linear systems of equations, matrix algebra, rank, trace, inverse, real functions, differentiation and integration • Vector space Rn: basics of analytical geometry • Linear transformations from Rn to Rm: matrices as illustrations • Spectral decomposition (intrinsic values and vectors) and singular value decomposition of matrices • Differentiation of multidimensional functions Probability Theory • Fundamentals: concept of probability, classical probability

	definition according to Laplace, conditional probability, theorem of Bayes, independence • Discrete and continuous random variables, probability, density and distribution function, expected value, variance, transformations of random variables multidimensional random variable (random vectors), covariance and correlation, dependency and independence, linear transformations of random vectors Special distributions, in particular: equal distribution, binomial distribution, poisson distribution, normal distribution, exponential distribution, multidimensional normal distribution
Reading List	Bosch, K.: Elementare Einführung in die Wahrscheinlichkeitsrechnung, Vieweg Fahrmeir, L.; Künstler, R.; Pigeot, I.; Tutz, G.: Statistik - Der Weg zur Datenanalyse. Springer Hartmann, P.: Mathematik für Informatiker, Vieweg+Teubner Mardia, K.V.; Kent, J.T.; Bibby, J.M.: Multivariate Analysis, Academic Press Teschl, G.; Teschl, S.; Mathematik für Informatiker. Springer Vieweg Wollschläger, D.: Grundlagen der Datenanalyse mit R. Springer
Further Information	This module is offered in English.