Module name	**Stochastics and Probability**
Module number	CMS-COR-SAP
Senior Lecturer	Prof. Dr. Ivo Sbalzarini ivo.sbalzarini@tu-dresden.de
Qualification objectives	After completing the module, students master the basics of stochastic modelling and simulation. They are capable of autonomously implementing stochastic algorithms and formulating new ones.
Contents	The content of the module shall include conditional probabilities, normal and scale-free distributions, transformation of random variables, simulation of pseudo and quasi-random numbers, Markov chains and their matrices representation, mixing times, Monte Carlo methods, in particular convergence, big figures law, variance reduction, Rao-Blackwell, importance sampling, Markov chains Monte-Carlo via Metropolis Hastings & Gibbs samples, random processes and Brown's movement, in particular properties in 1, 2, 3 and more dimensions, link to diffusion equation, Stochastic differential equations, in particular non-linear transformations of Brown's movement, Ito calculus, Ornstein-Uhlenbeck process and other resolvable equations, numerical simulation of stochastic differential equations, in particular of strong and weak errors, Euler-Maruyama scheme, Milstein scheme, Stochastic optimisation algorithms and exact stochastic simulation algorithms for reaction networks.
Forms of teaching and learning	The module includes lectures of 2 SWS, exercises of 2 SWS and self-study. The language of the lectures and exercises will be English.

Eligibility for participation	Knowledge of sequential computer programming, algorithms and data structures, analysis of functions of one or more variables, linear algebra, vector and matrices calculation, probability calculation and bachelor level statistics are required. The following literature is suitable for preparation: 1. Algorithms – the spirit of computing. David Harel. Addison-Wesley, 2004, 2. C++ from the ground up. Herbert Schildt. McGraw-Hill, 2003, 3. Structure and Interpretation of Computer Programs. HAL Abelson, Gerald Jay Sussman. With Press, 1985, 4. Introduction to Algorithms, 2nd edition. Cormen, T.H., Leiserson, C.E., Rivest, R.L. With Press, 2001, 5. Multivariable Calculus with Applications (Undergraduate Texts in Mathematics). Maria Shea Terrell, Peter D. Lax. Springer, 2018, 6. Linear algebra. Jim Hefferon, http://joshua.smcvt.edu/linearalgebra/, 2008.
Usability	In the Masters Course Computational Modeling and Simulation, the module is a compulsory optional module of the basic technical training, to be selected in accordance with Annex 1 to the Specific Examination Regulations. The module cannot be chosen in the Master's Course Computational Modeling and Simulation if this or a module with substantially the same content from a Course with which the entry conditions under § 3 of the Studienordnung have been met has already been completed. The module provides the pre-requisites for the modules it designates under the pre-requisites for participation.
Conditions for the award of credits	Credits are awarded when the module test is passed. The module test consists of a 90-minute away day. The language of the test will be English.
Credits and marks	The module allows 5 credit points to be obtained. The module score corresponds to the test performance score.
Frequency of the module	The module is offered every winter semester.
Workload	The total workload is 150 hours.
Duration of the module	The module covers 1 semester.